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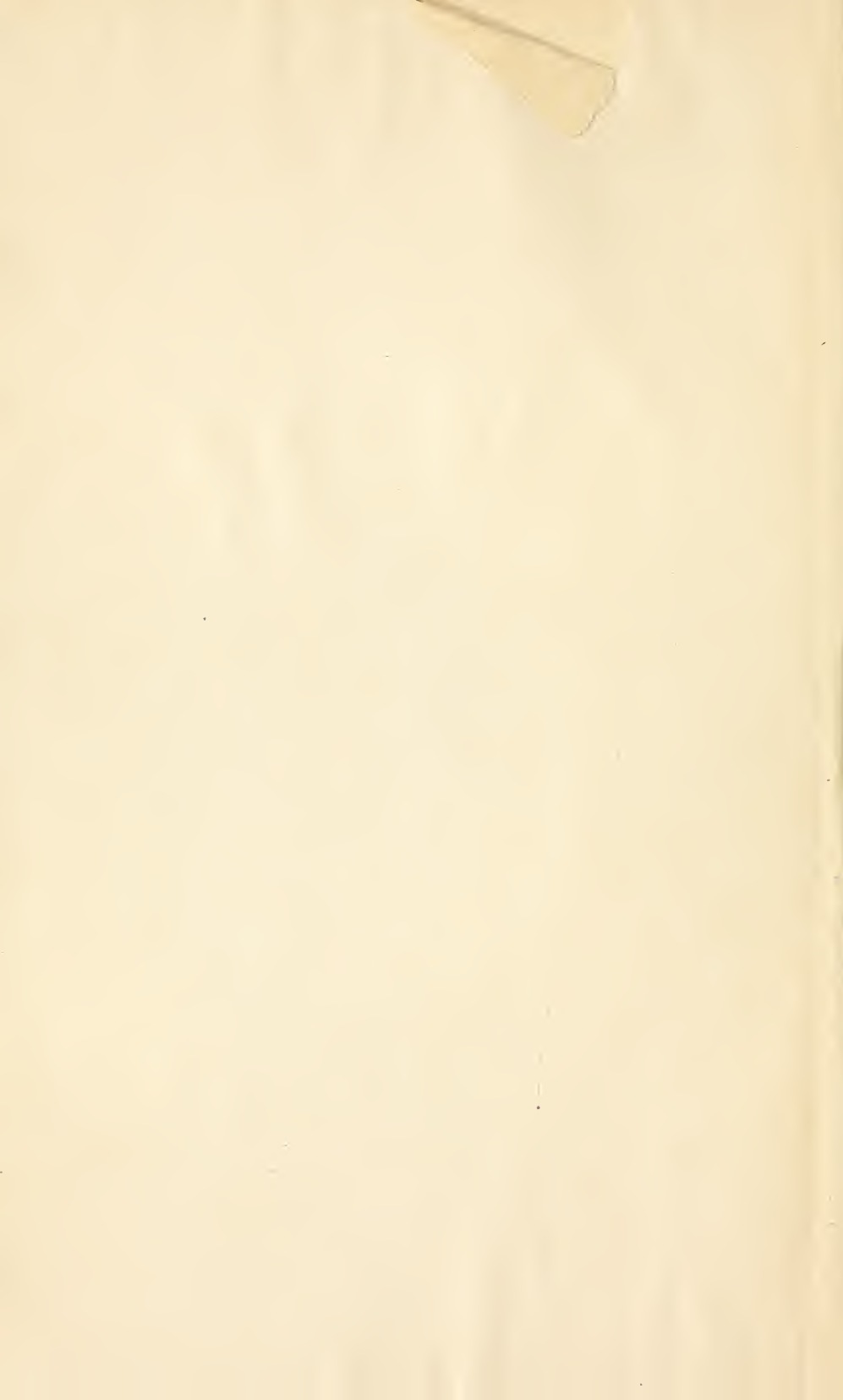
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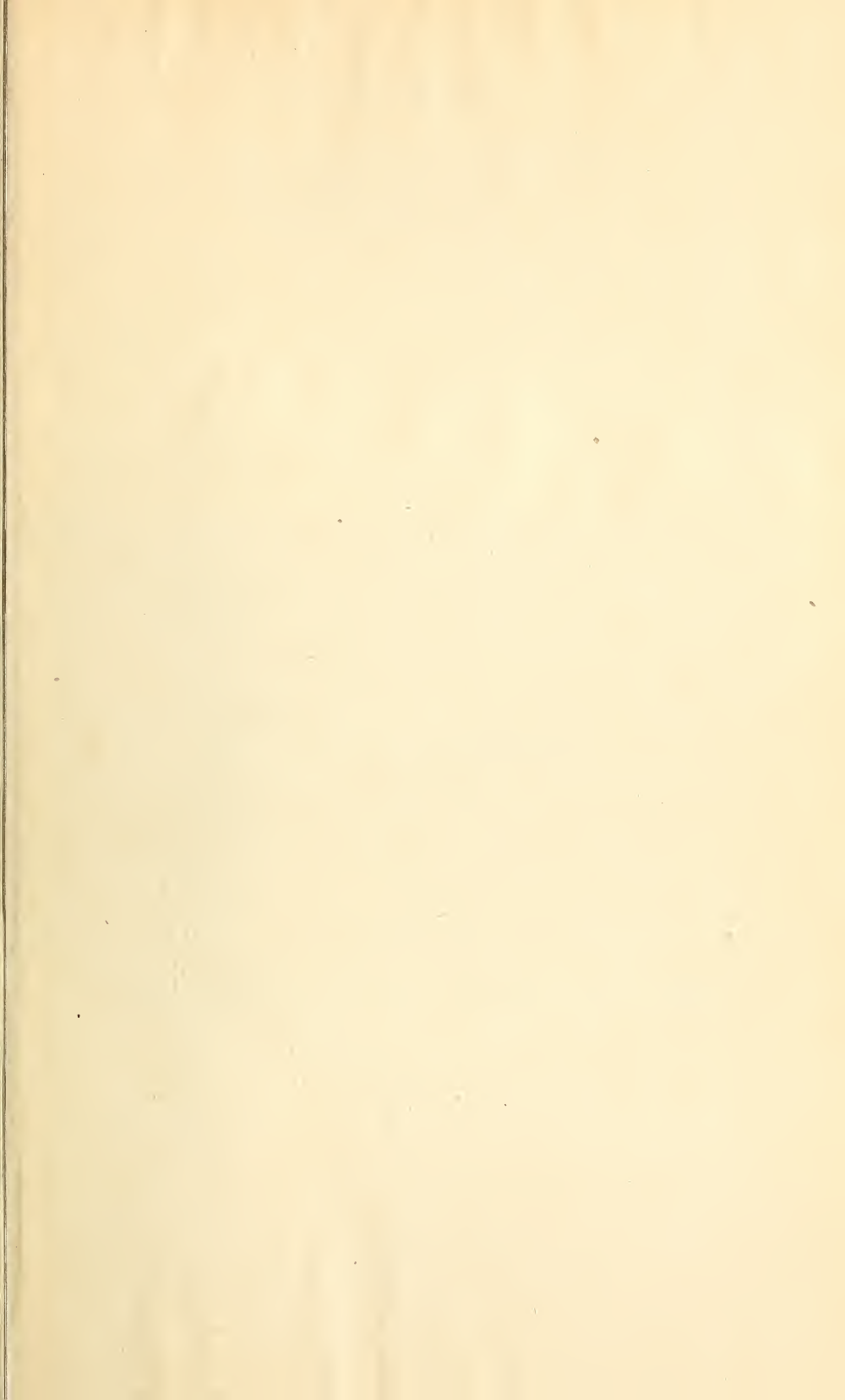
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ANNUAL REPORTS

OF THE

DEPARTMENT OF AGRICULTURE

FOR THE

FISCAL YEAR ENDED JUNE 30, 1899.

REPORT OF THE
SECRETARY OF AGRICULTURE.
MISCELLANEOUS REPORTS.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1899.



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REPORT
OF THE
SECRETARY OF AGRICULTURE.

REPORT

OF THE

SECRETARY OF AGRICULTURE.

TO THE PRESIDENT:

I have the honor to report upon the work of the Department of Agriculture for the year ending June 30, 1899. This report touches upon the work regularly carried on by the several Bureaus, Divisions, and Offices, and also indicates the new lines of scientific inquiry inaugurated by the Department for the benefit of producers in the several States. A brief summary precedes more extended consideration. I have also endeavored to give in sufficient detail the reasons for the estimates presented to Congress to carry on the work for the coming year.

SUMMARY.

WEATHER BUREAU.—The extension of the Weather Bureau service around the Caribbean Sea has been abundantly successful in noting the first indications of cyclones, forecasting their movements, and giving timely warning to our Navy, to merchant vessels, and to producers and others interested on land.

DIVISION OF CHEMISTRY.—This Division is becoming a necessity to every Department of the Government in the making of chemical analyses. Foods are investigated, preservatives of all kinds examined, sugar beets analyzed, etc. An interesting inquiry has been made into the change which takes place in the composition of grains grown repeatedly on the same soil.

DIVISION OF ENTOMOLOGY.—Since Dr. Howard has shown owners of Smyrna fig trees on the Pacific coast how to get the fruit fertilized, there is good reason to believe that in a few years we shall obtain our fine figs from that locality. Investigation by this Division shows that house flies and mosquitoes may be greatly reduced by removing the propagating conditions.

DIVISION OF BOTANY.—The Department is gathering information regarding the life history of the plants that supply commerce with india rubber and gutta-percha, and should Congress be pleased to give direction, it will seek the plant zones in our island possessions where these commodities may be produced. The United States now pays \$30,000,000 annually for rubber. We import between four and

five million dollars' worth of Egyptian cotton annually. Experimentation indicates strongly that, on suitable soils properly cultivated, this article can be grown here.

BIOLOGICAL SURVEY.—Plants and animals thrive and produce best where they are most at home. The Biological Survey is endeavoring to find the most congenial conditions for our plants and animals.

DIVISION OF VEGETABLE PHYSIOLOGY AND PATHOLOGY.—The hybridizing of grains is being conducted by the Division of Vegetable Physiology and Pathology, with a view to securing varieties (rust-resisting, drought-resisting, and cold-resisting) better suited to our varied soils and climates. Hybridization will also be applied in the immediate future to cotton, and efforts are now being made to get a hardier orange tree by the same process. The diseases of plants in the several States, including a serious fungous disease affecting sea-island cotton, and the diseases of fruit trees are also being studied.

DIVISION OF POMOLOGY.—This Division continues to experiment in many localities throughout the country with fruit-bearing trees, plants, and vines. For example, 119 varieties of the finer table grapes of Europe have been grafted on Phylloxera-resistant American stocks and sent to North Carolina and Florida. Special work is being done on the Pacific coast to get more definite data regarding the adaptability of varieties to that locality.

DIVISION OF FORESTRY.—The Division of Forestry is introducing practical and paying forestry on a large scale among lumbermen, and extensive experimentation in tree-planting is being conducted, with cooperation on the part of those interested in woodcraft in the several States.

DIVISION OF SOILS.—The irrigation farmer of the West is being helped by the mapping and extended investigation of alkali soils and by the reclamation of injured or abandoned land, many acres of which have become sterile through the injudicious use of water.

DIVISION OF AGROSTOLOGY.—Cropping reduces the organic material in the soil. Long-continued cropping renders the soil unproductive. Grasses and legumes are the best agencies for restoring this organic matter. The Division of Agrostology is experimenting with home and foreign grasses and legumes in all sections of our country, to build up worn-out soils in some cases and to introduce useful varieties in others.

OFFICE OF EXPERIMENT STATIONS.—Cooperation between the Department and the experiment stations becomes closer every year. Assistance from the States is increasing and the farmers of the several States are appreciating their station work more and more. Experimentation in Alaska has begun with Congressional aid. This work should be extended to Hawaii, Porto Rico, and the Philippine Islands, so that they may be enabled to supply the United States with tropical products, our importations of which amount to over two hundred million dollars annually.

OFFICE OF PUBLIC ROAD INQUIRIES.—There is great interest at the present time in the public highways of the country. Extensive experimentation is being conducted by the Department in cooperation with local authorities in building sample roads from the materials found in different localities, and in the laying of steel track.

DIVISION OF PUBLICATIONS.—During the year 603 publications were issued and over 7,000,000 copies distributed among the people. Of the Farmers' Bulletins, 2,437,000 copies were printed and distributed, which did not meet the full demand.

SECTION OF FOREIGN MARKETS.—Shows rapid growth of American commerce with all parts of the world. We continue to sell raw material to foreign countries, from which they manufacture high-selling articles. Trade regulations are prohibitory against American meats in some European countries where importations of cheap grains from which meats are made are encouraged. The American farmer can not afford to export nitrogenous grains or mill feeds for this purpose.

BUREAU OF ANIMAL INDUSTRY.—The work of this Bureau increases rapidly. Meat inspection was conducted last year at 138 abattoirs in 41 cities. The ante-mortem inspections were 53,223,176, while the number in 1892 was 3,809,459. The third year of experimentation with hog cholera shows that from 75 to 80 per cent of hogs injected with serum are saved. Encouraging results have come from the introduction of dairy products into foreign markets. The Department sends shipments abroad for the purpose of ascertaining the facts regarding such products; these facts are published, and commerce naturally follows.

DIVISION OF STATISTICS.—Fifty thousand crop reporters keep the Division of Statistics informed regarding the condition of our staple crops, and every effort is being made to promptly give the people the facts as they are found.

GARDENS AND GROUNDS.—The grounds of the Department and its extensive greenhouses serve a useful purpose, more than 100,000 plants and bulbs, all of economic value, having been distributed during the year by the Superintendent. This official is now prepared to supply tea plants for experimentation in the Gulf States.

SEED DISTRIBUTION.—The Department in the distribution of seeds is aiming to conform to the original spirit of the law by the importation and distribution of what is rare and valuable.

WEATHER BUREAU.

The establishment of stations around the Caribbean Sea has enabled the Weather Bureau to note the first approach of the West Indian cyclone and to warn shipmasters in port and interested persons on land, with remarkable certainty, of its approach.

EXTRACTS FROM THE REPORT OF THE CHIEF.

The following paragraphs, extracted from the report of the chief of the Bureau, set forth some important features of the work:

COLD WAVES.

Among the most important warnings issued by the Weather Bureau are those which give notice to agricultural and commercial interests of the approach of periods of abnormally low temperature. Warnings of this class have been particularly successful during the past year, and a not unimportant feature of the advices has been estimates of the probable continuation of injuriously low temperatures. In fact, a special effort has been made, and will be sustained, to afford all interests all the information regarding future weather conditions that is warranted by modern methods, appliances, and skill in forecasting. The recognized

accuracy of the temperature forecasts have caused them to be closely watched by various interests, and in the commercial centers movements of perishable goods are almost absolutely controlled by advices received from the Weather Bureau.

By far the most important cold wave, or series of cold waves, of the winter crossed the country from the North Pacific to the South Atlantic coasts during the first half of February, 1899, damaging crops and fruits in the Southern States to the extent of millions of dollars. During the first eight days of the month the lowest temperatures on record were reported at points in the North Pacific coast States; from the 9th to the 12th many places in the Central, Western, and North-western States reported the coldest weather on record. During the 13th and 14th the cold wave overspread the Southern and Eastern States, attended on the 13th by the lowest temperature on record from the Southern Rocky Mountain slope to the South Atlantic coast, by zero temperature to the Gulf coast of Alabama, and by a snowstorm of unprecedented severity in the Middle Atlantic States.

The Weather Bureau forecasts and warnings gave ample and timely notice to all interests of the advance of the cold wave, and special reports and newspaper comments gave unquestionable evidence that the warnings prompted protective measures whereby crops, live stock, and perishable goods and merchandise to the value of hundreds of thousands of dollars were saved. Along the Middle Atlantic and New England coasts the character of the storm called for the display of hurricane signals, the extreme warnings of the Bureau.

The detailed action taken in connection with this cold wave and storm and the numerous newspaper comments relating thereto, for which space can not be given here, will be found in the Monthly Weather Review for February, 1899. All reports and comments bear witness to the fact that the work of the Weather Bureau in connection with this, the severest cold wave in the history of the Southern States, was as nearly perfect as the most approved methods of disseminating warnings would permit. The amount saved by stockmen in the West and Southwest, by truck growers in the Southwest, and by fruit growers, gardeners, and orchardists in the Southern States, and more especially in Florida, is incalculable. The superintendent of the Florida East Coast Line reports that the warnings sent along his line of road, fifteen hours in advance of the cold wave, alone resulted in saving one-half of the vegetable crop, and that the value of the crop was estimated at \$1,000,000. The exceptionally severe character of the storm along the Middle Atlantic and New England coasts amply justified the special warnings sent to that section.

CLIMATE AND CROP SERVICE OF CUBA AND PORTO RICO.

In the latter part of October, 1898, instructions were given to the official at San Juan, Porto Rico, to establish a climate and crop service in that island, and later similar action was taken in Cuba. Sufficient instruments and shelters of standard pattern were sent into both islands and voluntary stations established as rapidly as the cooperation of efficient observers could be secured. By the opening of the new year the issue of the Weekly Climate and Crop Bulletin had begun in Porto Rico, and similar bulletins for Cuba were first issued about the middle of May. The illness of the official in charge unfortunately interrupted the work of the Porto Rico section, which, however, was resumed in May and has since continued. Arrangements have been completed by which monthly section reports, after the standard, for both Porto Rico and Cuba will be issued hereafter, work on the first report, that for May, 1899, for Porto Rico, being well in hand. Notwithstanding the serious difficulties which were encountered in the prosecution of the climate and crop work in these islands, due in a great measure to the fact that the Spanish language is exclusively spoken, much has been successfully accomplished, as evidenced by the fact that both sections issued weekly bulletins with regularity after the middle of May.

From the many courteous and complimentary communications that have been received and notices published in the newspapers, both on the islands and in the United States, it is evident that the efforts to establish this service have been successful and have met a popular need. As the residents of the islands become more conversant with the aims and scope of the service they will appreciate more fully what a great benefit it is, both climatologically and financially.

LOSS OF LIFE AND PROPERTY BY LIGHTNING.

The collection of statistics of loss of life and property by lightning, referred to in a previous report, has been continued. The number of deaths by lightning stroke in the calendar year 1898 was 367 and the number of injuries 494. The places where the proportion of deaths to total population was the greatest were

the Upper Missouri Valley and portions of the Rocky Mountain region. The proportion of deaths by lightning in the United States to the total population is about five in a million, which, it may be remarked, is higher than the average of most countries.

Nine hundred and sixty-six barns, sheds, etc., 735 dwellings, stores, and office buildings, 95 churches and schools, and 70 other buildings were struck and damaged by lightning, the approximate loss being about a million and a half dollars. Of the buildings struck, 40 were provided with lightning rods, 855 were not, and in 953 cases it could not be ascertained whether the building was provided with rods or not.

Nine hundred and sixty-four head of cattle, 306 horses, 30 mules, 426 sheep, and 116 hogs were killed by lightning during the calendar year above referred to. The total value of the stock reported killed was \$48,257.

Lightning has caused great loss of life and property thus far during the calendar year 1899.

AERIAL OBSERVATIONS.

At the close of the last fiscal year 17 kite stations were in operation and 248 ascensions had been made, in each of which the elevation attained exceeded 1,000 feet. The work was continued until about the middle of November, 1898, at which time 1,217 ascensions of 1,000 feet and over had been made.

The study of the records of temperature, pressure, and humidity thus secured was intrusted to Mr. H. C. Frankenfield, forecast official, whose first report has been submitted. For the first time in the history of meteorology we have facts instead of hypotheses as to the average gradient of temperature up to 6,000 or 8,000 feet, free from all injurious influences, and for so many days and over such a large region of country that it has a broad significance; evidently it is the only proper gradient to be used in reducing atmospheric pressures or temperatures, up or down, from any observer's level. Notwithstanding the imperfections attending the beginnings of any such entirely novel work, these 17 stations, with their 1,217 ascensions in the course of six months, have probably added more to our knowledge of vertical gradients of temperature, humidity, and wind, in the daytime of summer, in the lower portion of the atmosphere, than the sum total of all that was previously known upon the subject.

STUDY OF TEMPERATURES AT STATIONS IN ALASKA.

The Bureau is studying the temperatures at stations in Alaska to learn what effect they may have on rainfall in California, and when cables are laid around the Pacific, with observers stationed at numerous places, the ocean currents and their effect on our Pacific coast, being more intelligently studied, will be better understood. The severe cold wave of last winter that destroyed so many fruit trees suggests the continued improvement of our means of observation.

RECOMMENDATIONS.

The greatest returns from the large sum (\$1,022,482) spent annually in the maintenance of the Weather Bureau are from the warnings to marine interests of destructive storms and predictions of cold waves and frosts for the benefit of agriculture and commerce. An appropriation of \$95,000 for the purpose of equipping storm-warning stations with improved lights and durable iron flagstaffs and towers from which these important signals can be advantageously displayed is urgently recommended; also an increase of \$25,000 in the fund for telegraphing weather reports and improving the river and flood service in order to meet the numerous demands now almost daily made upon the Weather Bureau of this Department by boards of trade, cotton exchanges, marine associations, and large individual owners of ocean, lake, and river property.

DIVISION OF CHEMISTRY.

This Division has continued its study of various soils under identical conditions with satisfactory results. Improved methods of analysis have been devised and published for the benefit of agricultural chemists throughout the country.

Much time and attention has been given to the investigation of food products to ascertain the composition and nutritive value of commercial foods, and definite data have been secured.

Careful and systematic research has been made in this Division for preservatives of all kinds which may have been used on meats. The attitude which the Department should take toward preservatives has been frequently outlined in official reports, but it may be as well to restate it here, as the matter is of great importance. It is well stated in the report of the Chemist, as follows:

It is not regarded as a wise thing to absolutely prohibit the use of preservatives in foods. Since, however, all chemicals which have the properties of preserving foods also have a tendency to interfere with the processes of digestion, it is held to be imperative that no food should be offered for sale which contains a preservative without having this fact plainly stated upon the label of the package. Not only should the label state that the food product contains a preservative, but it should also give the name of the preservative and the quantity employed. In this way the intending purchaser is fully informed in regard to the character of the product which he buys. While it has been established that a healthy stomach can, from time to time, receive with impunity food containing small quantities of preservatives, it is by no means certain that the continued practice of ingesting preservatives in foods would not produce serious injury. On the other hand, it is also quite certain that weak or diseased stomachs may suffer temporary or permanent injury from even minute quantities of preservatives.

Twenty tons of high-grade sugar-beet seed were imported from Europe for distribution under the supervision of the Chemist. This was sent out mainly through the experiment stations of the States and Territories interested in beet culture. Analyses of beets have also been made by the Division for all recipients of this seed desiring such service.

The State, War, Treasury, Justice, Post-Office, and Interior Departments of the Government frequently call upon the Department of Agriculture to have chemical work done, which suggests the wisdom of preparing to do this work through statutory provision recognizing the Division of Chemistry and providing means to enable it to serve all the Departments.

Deterioration in the gluten content of wheat is being inquired into.

DIVISION OF ENTOMOLOGY.

There are very large numbers of Smyrna fig trees in California that have never matured fruit because the flowers were never fertilized. Dr. Howard, chief of this Division, suggested the importation of an insect (*Blastophaga grossorum*) which in the Mediterranean countries fertilizes this fig. This has been successfully done, and the insects have multiplied and fertilized many figs that matured.

Dr. Swingle, who made the importation, is carefully studying the habits of the insect and teaching the owners of the trees regarding it. There is good reason to hope that our country will get its figs in future from the Pacific coast. The Division continues its study of injurious insects that may invade our territory from contiguous countries. Volunteer observers for this Division are studying injurious Porto Rican insects. Sets of injurious insects are being received from several foreign countries with which we have intercourse. Insects are being studied that are destructive to forests in the North-western States. The life history of the San Jose scale, through the work of this Division and State officials, is now well understood. Experimentation in this Division to learn whether this scale would live on dried fruit has convinced most foreign importers that they may safely handle this product.

Investigation is being made by this Division regarding the ability and likelihood of house flies and mosquitoes to carry disease; also by many scientists, who call upon Dr. Howard for exact information bearing upon the life histories of these insects. Life histories of insects injurious to garden crops, grasses, and tobacco are being made out. The Mexican boll weevil is under consideration and the geographic distribution of insects is being carefully mapped, both lines of work in cooperation with local entomologists. Experimental work with remedies and their effects on foliage has been undertaken. The honey bee is being studied along practical lines, such as the preventing of swarming, queen rearing, and the like. Much inquiry comes regarding the large bee of the East, which we will import as soon as arrangements can be made.

DIVISION OF BOTANY.

The many deaths of human beings and farm animals caused by poisonous plants justify continued work by this Division with regard to them. Several hundred tests have been made of seeds bought in the open market, showing that imported grass seed, particularly, requires the attention of the Department on account of its impurities. Dealers in these articles have been warned, and further tests will be made. The work of seed and plant introduction has been attached to the Division of Botany in order to avoid multiplicity of supervision. During the last year explorers have been sent to Russia to secure superior varieties of cereals resistant to cold, drought, and fungous diseases.

One explorer went to Japan to procure varieties of rice possessing high milling qualities, for cultivation under the new system in Louisiana and Texas, by which the rice fields can be flooded when necessary and dried at pleasure to admit the harvester. A testing garden has been secured on the Potomac flats, through the courtesy of the War Department, where observation may be had of plants introduced from

foreign countries, so as to avoid new plant diseases. The acquisition of tropical islands by the United States has brought many inquiries to this Division regarding the cultivated plants of the Tropics. There is now widespread interest in tropical agriculture and a demand for correct information on the subject, which the Department must be prepared to satisfy.

BIOLOGICAL SURVEY.

During the fiscal year 1898-99 field work was carried on in four States (California, Maryland, Nevada, and Texas) and two Territories (New Mexico and Alaska), and also in British Columbia and Northwestern Territories. In 1898 the principal work was done in California and in 1899 in Texas and Alaska. Work was done under the direction of the chief of the Division on Mount Shasta and in the surrounding country. Several life zones were run from the bottom of the Sacramento and San Joaquin valleys to the summit of the Sierra, and also in other valleys of the Pacific coast. The rapid settlement of Alaska has attracted attention to that Territory. A favorable opportunity for investigation was afforded our biologists through the liberality of Mr. Edward H. Harriman, of New York, who fitted up an expedition for a trip along the Alaska coast.

During the year 1,381 bird stomachs were received and 1,961 were examined in the laboratory. The collection contains 31,300, the accumulation of fourteen years; less than 50 per cent have been examined. Detailed reports of some of this work have been published by the Department. The object is to obtain reliable data respecting the food habits of these birds and to determine their value or possible injury to the farmer. Considerable work has been done to determine whether birds show marked preferences in selecting food or simply eat what is most abundant. Work continues along the line of comparing and tabulating data and mapping the geographic distribution of birds. Similar data have been tabulated for mammals.

The Biological Survey has determined the natural crop belts of the United States and has undertaken to map their boundaries and to prepare detailed lists of the agricultural products adapted to each. A preliminary report on this subject, illustrated by a colored map, has been already published (Bulletin No. 10, Division of Biological Survey). By ascertaining in advance the areas suitable for each variety of fruit, vegetable, and cereal, the Biological Survey aims to put a stop to the present indiscriminate and wasteful experimentation in which farmers spend vast sums of money each year vainly trying to force crops to grow in places unfit by nature for their cultivation.

The crop belts have been found to conform to certain temperature conditions and to coincide with natural belts inhabited by particular kinds of animals and plants, so that their boundaries may be fixed

by a study of the geographic distribution of our native species. The work of mapping the life belts can be done only by experienced field naturalists. Persons qualified by knowledge and experience are few and difficult to secure, regardless of compensation. The Department, owing to the limited means at its disposal, has not only been unable to increase the small force long engaged in this work, but has lost several assistants who have resigned to accept better positions elsewhere, for each year members of the Biological Survey are offered salaries much higher than those the Department is able to pay. No increase in the appropriation has been made for seven or eight years, as a consequence of which it is impossible to carry on the work as economically as could be done with a slightly larger and better equipped force. Much time is lost in fitting young and inexperienced assistants to replace those who resign to accept more profitable positions elsewhere; and it is often necessary to extend a piece of field work over several seasons which might be completed in a single season, with a considerable saving in expense.

DIVISION OF VEGETABLE PHYSIOLOGY AND PATHOLOGY.

This Division has been making a careful study of plant nutrition, the heredity of plants, and improvement by breeding and selection. While the Department is endeavoring to ascertain, through the Biological Survey, where plants are most at home and under what climate and soil conditions they prosper best, the Division of Vegetable Physiology and Pathology studies the phenomena of plant life itself. The diseases affecting timber are being studied in order that something may be published for the benefit of the public during the forthcoming year. When our people become alive to the necessity of reforesting many parts of our country the value of a correct knowledge of the diseases affecting living trees will be more apparent.

The diseases of trees are as a rule of such a nature as to necessitate much careful investigation to discover the causes. Some are due to unfavorable surroundings, such as soil or plant food, or to the presence of noxious substances in the soil and air. The little-peach disease in Michigan threatens to cripple the peach industry seriously unless some means of checking it are found. A scientist from this Division has been detailed to study the conditions and obtain all the light possible on this disease in Michigan and elsewhere. Definite conclusions have not been reached. The past summer has not been favorable for studying the disease, because during the severe winter of 1898-99 many trees partially diseased were killed outright.

The study of pear blight has been continued, also diseases of white and sweet potatoes. It was found that a serious disease of the sweet potato can be prevented by a simple treatment with formalin solution. A serious fungous disease is affecting the sea-island cotton. One of

our ablest men has been detailed to study the matter on the spot. This disease attacks other plants than cotton, and seems to be spreading. The fungus appears to be of great vitality, and may live in the soil for years, attacking the cotton plant when planted again after other crops. In connection with this work it is proposed to inaugurate experiments in breeding cotton, which will have for their object the improvement of varieties of the crop both as regards marketable qualities and ability to resist various diseases.

The pathologist who has charge of plant breeding has been detailed to assist the Section of Seed and Plant Introduction for the greater part of the year, and in Russia and other wheat-producing countries he secured varieties as a basis for future work, in addition to collecting large quantities of cereals for distribution. Another scientist from this Division has been detailed to assist the Division of Soils in extensive work on the curing and fermentation of tobacco. Advances have been made by this Division in the use of pure yeasts for the production of grape, apple, berry, and other wines. The yeasts have been introduced from Germany by agents of the Department. Cultures of these yeasts were made to determine their purity, and after this preliminary work experiments were made to determine their effects upon the fermentation of cider. Our people have been selling apple parings, apple corings, dried apples, and cheap apples by the ton to foreigners, who, with the aid of these yeasts, have been making very desirable articles of commerce. It is designed that our own people shall have the benefit of these discoveries in the future.

Questions have arisen regarding the effects of continued spraying with copper sulphate—as to whether its accumulation in the soil after long use will render the soil sterile. The nature of this work is such that it will take some years to carry it to a successful conclusion. This Division renders much assistance to the Section of Seed and Plant Introduction by inspecting new seeds and plants, so as to avoid the introduction of new fungous and parasitic diseases, and also by treating the grains imported and distributed by the Department. Plant breeding is attracting more attention than usual. An assistant of this Division was sent to attend the International Conference of Plant Breeders in London during the present year, so as to make himself familiar with the methods pursued in foreign countries. The work that may be done in improving plants by breeding is quite analogous to that which has been done in improving domestic animals by the same method.

The production of large varieties through selections that will improve either plant or animal; the development of varieties for particular purposes, as is done in the case of animals; the cross-breeding of plants, so as to develop varieties that will be more hardy, fungus resisting, drought resisting, early maturing, or late maturing,

are all under consideration. It is hoped by hybridizing to get a hardier orange tree for the Southern States, and thousands of cross-bred plants were sent out this spring with this object in view. Seedling pineapples secured by crossbreeding are ready for sending out, and will be placed in suitable localities. Arrangements have been made with the Nebraska Agricultural Experiment Station for cooperative work in crossing corn. An interesting field is offered here, as this cereal is one of the great staple crops of the country and nothing has been done along this line. Selection has been relied upon altogether for the improvement of this cereal.

The agent of this Division on the Pacific coast is at work on peach-leaf curl and on diseases of lemon, orange, and walnut trees—industries in which the people of the coast are vitally concerned. The crossing of raisin grapes has progressed far enough to warrant the statement that time and judicious work are all that are necessary to obtain the hardiness of plant and the required fruiting qualities in California, Arizona, and Nevada.

The subtropical garden located in Florida is used in making preliminary tests of hybrid fruits obtained in the regular work of the Division and also to test the new plants imported by the Section of Seed and Plant Introduction, about which we desire further information before distribution. This garden has hybrid citrous, orange, lemon, lime, and guava trees and a large number of seedlings. Pineapple plants and imported French grapes are being tested with a view to determine their value for the Southern States.

DIVISION OF POMOLOGY.

The distribution of fruit-bearing trees, plants, and vines has been largely increased during the past year owing to the facilities afforded by the Section of Seed and Plant Introduction, and thus the theories of specialists can have a practical application. During the year 2,700 lots have been placed with about 275 experimenters in various portions of the country. Consul Merriam at Iquique has sent us a lime from the interior of Chile and a reputed hardy type of alligator pear. The last mentioned is being thoroughly tested in the Southern States. A reputed hardy variety from Mexico is also being experimented with.

Experimentation under the direction of the Division is being conducted in North Carolina and Florida, with a view to the successful production of the finer table grapes of Europe. One hundred and nineteen varieties grafted on Phylloxera-resistant American stocks have been planted by the experimenters, as well as 43 varieties of "direct producers" and "resistant stocks." These vines were imported through the Section of Seed and Plant Introduction, and more varieties will be added during the coming year, so as to have thorough and

comprehensive tests made of all varieties likely to be useful. A better knowledge of fungous diseases at the present time gives hope that we can produce these fine grapes more successfully than was done a number of years ago, before the science of applying fungicides was so well understood. The results of experiments in root-grafting by this Division are being prepared for publication.

A catalogue of fruits recommended for cultivation in various sections of the United States by the American Pomological Society, which was published in 1897, has been thoroughly revised by a committee of that society working in cooperation with the divisional force. To secure more definite data regarding the adaptability of varieties on the Pacific coast, Prof. E. J. Wickson, of the University of California, was last year appointed a special agent to conduct special investigations on the subject among the growers of that region. Extended preliminary investigations of the conditions of the fruit industry in Idaho, eastern Oregon, and western Washington were made by the Pomologist during the autumn of 1898. The fruit industry as a commercial enterprise is comparatively new in both these sections. The outlook for the commercial fruit grower there is very promising.

The unusually low temperature reached in 1899 worked permanent injury to the trees and vines in many sections. Many that were supposed to be hardy have been killed outright in many localities. The Division of Pomology is endeavoring to ascertain the facts with regard to varieties, so that it may be able to make recommendations for certain localities.

In preparing a horticultural exhibit for the Paris Exposition the Division will secure such fruits especially as are now in demand or may find a market in foreign countries. Canned, dried, and evaporated fruits and vegetables will be shown in great variety. The apple and the orange will be prominent among fresh fruits, and the pecan and shagbark among nuts. Everything is being done along these lines to inform the world regarding our marketable products and to assist merchants in finding markets.

DIVISION OF FORESTRY.

The work of this Division has been entirely reorganized during the year. This and the introduction of practical and paying forestry among lumbermen on a large scale, the extensive investigations in tree planting, preparatory to practical work with tree planters, and the widespread interest and cooperation in the work, especially among lumbermen, are the most important facts to be reported. A striking instance of this cooperation is the action of the redwood lumbermen of San Francisco, who voted to subscribe \$1,000, and offered free transportation and free subsistence in their camps to our agents,

so as to advance by one year the time when the Division, delayed by lack of funds, could begin work on the growth and reproduction of the redwood.

Notwithstanding the increased appropriation made by the last Congress, it is still utterly impossible to cover the field of necessary action. Very many demands made for work of great importance to the preservation and proper use of forests in the United States can not be complied with for lack of means. It is earnestly hoped that the Division may be enabled during the next fiscal year, through a largely increased appropriation, to take advantage of the unprecedented opportunities created by the rapid public awakening to the meaning and value of practical forestry.

At present all work in the Division is assigned to four sections, each one in charge of a man of special knowledge and qualifications. These are: The section of working plans, which has charge of all practical work in the woods; that of economic tree planting; that of special investigations, dealing with the habits and characteristics of trees which affect their use in practical forestry; and that of office work. But two of the various grades of technical assistants under the heads of sections require mention here.

COLLABORATORS AND STUDENT ASSISTANTS.

The first grade is that of collaborator. The collaborators are experts of established reputation on forestry, lumbering, or tree planting, and are scattered throughout the country. They prepare and forward for publication treatises on subjects previously agreed upon. Through them the best experience of trained specialists becomes available to the Division at a very moderate cost. The pay of a collaborator is \$300 a year.

The grade of student assistant was created to provide trained men for the future needs of the Division and to supply it immediately with assistants of high intelligence at small cost. Twenty-eight of these assistants have been employed during the summer, the majority of whom are college or university men. Only those who have declared their intention to adopt forestry as their profession are received. In the field they work under the supervision of trained foresters, especially in the preparation of working plans and the study of commercial trees. The pay of a student assistant is \$25 per month.

Both collaborators and student assistants have been of marked value to the work of the Division.

PRACTICAL ASSISTANCE TO FARMERS, LUMBERMEN, AND OTHERS.

Last October a circular was issued (No. 21 of the Division of Forestry) offering advice and practical assistance to farmers, lumbermen, and others in handling their forest lands, with a view of bringing

about the substitution of conservative for destructive methods. This offer provided for the preparation of working plans, with full directions for work and with practical assistance on the ground, without cost to the owners of wood lots, but in the case of larger tracts requiring the owners to meet expenses for travel and subsistence, and for the necessary helpers for the agents of the Division while in the field.

During the year applications were received from 123 owners in 35 States for the management of 1,513,592 acres. Of these applications, 48 were for large tracts covering together 1,506,215 acres, the remainder being for wood lots.

Personal attention on the ground was given to 41 tracts, covering about 400,000 acres in 19 States. The contribution of private owners to the expenses of this work was about \$3,000.

It was found possible for the owners of a majority of these tracts to carry out the working plans without personal assistance, but 15 of them required the active participation of the Division. On two of the latter, comprising 108,000 acres, the working plans were put into execution early in the year, and the first year's work has been successfully completed. The second year's work is being pursued under very favorable conditions.

As a result of a calculation, based on exact measurements, of the amount of lumber wasted by the prevailing practice of cutting high spruce stumps in the Adirondacks, there has been a decided change for the better on certain tracts, and at the same time a great reduction in the amount of young spruce cut for road building has been brought about. These are important changes.

In connection with the preparation of the working plans for the two large tracts in the Adirondacks, a special study has been made of the growth and production of the spruce on the eastern side of the mountains and of birch and maple on the western slope.

Of the total amount of land submitted for working plans, about 1,200,000 acres have not yet been examined. These tracts will be considered during the ensuing year as fast as the very inadequate force of the Division will permit, and working plans will be made for a selected number.

The Division has been thoroughly equipped with instruments for field work, in which it was wholly lacking at the beginning of the year.

COMMERCIAL TREES.

During the year five species of commercially valuable trees have been studied to determine their rate of growth and to ascertain their special qualities in forestry. The more important of these studies relate to the loblolly pine, in North Carolina, a tree of the first economic importance, and the red fir in Washington, also called Douglas fir, yellow fir, Oregon pine, etc., one of the most valuable and widely

distributed trees of the world. These studies have met with the cordial approval of lumbermen, and much practical assistance has been rendered by them. In addition the study of the coast redwood in California has recently been begun, and later, if enough money can be saved for that purpose, the white oak and the hickories will be taken up.

ECONOMIC TREE PLANTING.

The planting of experimental plats in cooperation with State agricultural experiment stations has been discontinued, and the stations have taken over the plantations and assumed the responsibility for them. This was done after a thorough study of the old plan, after careful examination of the plantations at nine of the eleven stations, and with the acquiescence of the authorities of every station. Two other lines of work have taken the place of experimental tree planting. One is a careful study of the results of the planting already done, in which all the species used in the cooperative plantations are represented, and from which practically all the results to be expected from them after many years may be gathered without delay and far more cheaply; and the other the giving of practical assistance to tree planters under the terms of an offer (set forth in circular No. 22, Division of Forestry) similar to that made to forest owners.

Close relations have been established with five of the most competent men in the treeless regions, and these gentlemen are preparing reports on subjects of direct interest to tree planters.

In addition to the studies now being pursued the work of the present year will in great measure be devoted, first, to giving practical assistance to tree planters in the selection of the proper trees to plant and in planting them rightly, and, secondly, to an attempt to determine the true effect of bare and wooded or brush-covered slopes on the run-off of streams. The vast interests affected by the solution of this difficult problem will justify the most persistent and careful work.

SPECIAL INVESTIGATIONS.

Forest fires have been studied historically and in the field, and important results have been reached. Records of more than 5,000 fires have been compiled and classified, and field work has been prosecuted in seven States.

A series of studies of North American forests by experts with special knowledge of definite localities is in progress, and it is expected that three of them will be completed during the coming winter.

Historical studies of the progress in forestry in New Jersey, Massachusetts, and other States have been begun, and those for New York are practically completed.

Much material has been collected for a general account of the

progress of forestry in the United States and of the practical application of conservative forest treatment in this country up to the present time.

Noteworthy progress has been made during the year in the photographic forest description of the United States.

OFFICE WORK.

The mailing list has been revised and extended, especially among newspapers, and much material for publication has accumulated and awaits attention during the winter. The botanical work formerly carried on by this Division has been turned over to the Division of Botany, where it more properly belongs.

During the year the force has been much increased, largely by the addition of young American foresters. At its highest, the total membership was more than five times that at the beginning of the last fiscal year.

PLANS FOR THE ENSUING YEAR.

Except for the new work referred to above, the plans of the Division, which have received my approval, do not contemplate any material changes from the lines of effort pursued in the year just past.

DIVISION OF SOILS.

FIELD OPERATIONS.

The Division of Soils has continued and considerably extended the investigation and mapping of the alkali soils of the irrigated districts of the West, mentioned in my last report, with results which are at once interesting and practically important to the irrigation farmer. Three field parties have been out during the season mapping a small area in the Yellowstone Valley in Montana; also about 150 square miles in the Pecos Valley, New Mexico, and 250 square miles in the vicinity of Salt Lake City, Utah, with a reconnoissance over a much larger area. Short circulars are being prepared for immediate and wide circulation calling attention to the conditions due to, and the best measures to prevent injury from, alkali or seepage water, as well as the best means for the reclamation of injured or abandoned lands. Fuller reports will then be prepared, with detailed soil and alkali maps on a scale of an inch to the mile, to be published in a volume covering the field operations of the Division during this year.

The trouble from alkali is due primarily to the large amounts of soluble salts generally present in all soils of an arid region. The rainfall is not sufficient to carry off the salts as they are set free in the decomposition of the rocks. These salts are naturally distributed

throughout the soil, and for a few years are not harmful. With the application of irrigation water, however, in the intensive cultivation of crops, the excess of water accumulates and is liable to fill up the subsoil, and this, together with the rapid evaporation in an arid climate, shifts the salts until they gradually accumulate at or near the surface in such quantities as to be beyond the endurance of crops. The natural drainage has of course a great influence on such an accumulation of both seepage waters and alkali.

Another, and perhaps the most important, cause of the rise of the subsoil water and accumulation of alkali is in the leakage or seepage from canals. As such damage is liable to be widespread, it is a matter for serious consideration whether canal companies should not be required to protect their ditches from undue loss, and individuals be restrained from overirrigation or made liable for damages in civil suits.

Another source of trouble is in the use of water for irrigation containing too large a salt content. Cases have been brought to my attention where land companies have, through extensive advertising, attracted many settlers, only to deliver water which the companies had previously been informed contained too much alkali for irrigation. Such action only invites widespread suffering and loss to the settlers.

In some districts the condition of the water can be controlled, in a large measure, by the water companies. Reservoirs are frequently lowered for repairs or for cleaning out at the beginning of a long dry period, and the remaining water concentrates by evaporation until it is really unfit for irrigation if the inflow is small and the usual floods are delayed. Furthermore, the first flood after a long dry spell often brings down great quantities of alkali, which have accumulated on the watershed during the dry season. Frequently these first flood waters should be diverted from the reservoirs, in order to prevent serious damage to the community.

These matters are clearly set forth in the report of the chief of the Division of Soils and in his statement of the field operations of the Division, to which attention is called.

RECLAMATION OF ALKALI LANDS.

When the alkali contains considerable quantities of carbonate of soda, the usual remedy is heavy applications of gypsum with drainage, if necessary, to insure thorough aeration of the land. When the other alkali salts or seepage waters have accumulated in excessive quantities, drainage is necessary.

So sudden and unexpected is the damage from the rise of seepage waters and alkali that estates worth thousands of dollars may have to be abandoned in two or three years, with an utter depreciation of value.

So widespread is the damage that in one tract alone near Salt Lake City there are 100 square miles of practically abandoned land, partly within the city limits, formerly containing some of the most fertile lands of the valley, which would have, under a conservative estimate, a value of over \$3,000,000 if the original conditions could be restored. With the encroachment of the alkali the farmers are moving back on the higher levels.

The matter of artificial drainage, as a means of preventing damage and of reclaiming alkali lands, has been so often advocated without attracting the attention necessary to induce action, and the matter is of such vital importance to the West, that I have recommended to Congress an appropriation of \$10,000 for the purpose of actually demonstrating the practical utility of the different methods of treating such lands.

SOIL MAPPING IN THE EAST.

Equally important work is being done in the eastern district of the country. Part of this will be referred to under "Tobacco investigations."

The methods of field soil surveys have been worked out in the past few years in this Department, and men have been carefully trained for such work. As no such training exists elsewhere in this country, several of the experiment stations and State geological and economic surveys have been glad to avail themselves of the cooperation of the Department, thus, while contributing to the expenses of the work, being relieved of the direction and responsibilities of making soil surveys of their States. Thus, a detailed soil survey has been undertaken of the soils of Maryland, in cooperation with the geological survey of that State, and of Louisiana, in cooperation with the State experiment station. Such cooperation will be encouraged so far as competent men can be obtained and the means at our disposal will permit. Other States are willing to contribute money, but the difficulty has been to obtain men and to find the time required to train them. There is a wide and valuable field in this work for the graduates of our agricultural colleges who are willing and able to undergo the necessary training.

TOBACCO INVESTIGATIONS.

The investigations of the tobacco soils of the country by the Division of Soils has shown so much of importance that last year I asked Congress for an appropriation to extend and supplement this work. This request was granted. The money was not available until the first of July, 1899, but since that time a large amount of the most important work has been done, which will be referred to in my next Annual Report. Briefly, this work includes the mapping of 400 square

miles in the Connecticut Valley, including the principal tobacco areas of that important locality. This map, which is being prepared for publication, shows the character of the soils and their distribution.

The soils occur in more or less well-defined terraces, formed by the old lake which covered that area in prehistoric times. The highest terraces, or the old lake bottom, are coarse sand, containing fine gravel. These "plains" soils produce the finest wrapper leaf when the season is favorable, but on account of the droughty character of the section such crops are only obtainable about two years in five. Some practical method can no doubt be found to make the crop more certain.

The next lower terrace is of finer sand, and it is upon this that the general crop of Havana seed leaf is produced. The next terrace is of still finer sand and produces the fine broad-leaf variety, while the lowest terrace, or the present meadows, is of such fine silt that it produces a coarse dark tobacco unsuited to the present market demands. There are other soils upon which tobacco can not be grown, and still others upon which tobacco of peculiar properties is produced, suited to certain trade. The map will show these soils in different colors.

CAUSE OF THE FERMENTATION OF TOBACCO.

To supplement this soil work the Division of Vegetable Physiology and Pathology is cooperating in the study of the cause of the fermentation of tobacco. It has been found that the flavor and aroma are due not to bacteria, as was formerly supposed, but to enzymes or oxidizing agents in the leaf itself. The formation of these oxidizing agents and the conditions of their greatest activity are being studied.

It has been found that some of the soils of the Connecticut Valley are similar in all essential respects to the soils of Florida and Cuba, and an effort will be made, through changes in the methods of cultivation and fermentation based upon these investigations, to improve the quality of the Connecticut leaf so as to adapt it better to the present demands for wrapper for high-priced cigars. Next year it is proposed to investigate the soils of Pennsylvania and Ohio to see if the quality of the filler leaf grown on the heavier soils of these localities can not be greatly improved.

PHYSICAL AND CHEMICAL INVESTIGATIONS.

To supplement and support the field work of the Division, various investigations are being carried on, partly with the cooperation of the Division of Chemistry, in relation to many intricate soil problems, such as the retention and movement of the water through soils; the physico-chemical effect of fertilizers in soils; the absorption of salts; the physical properties of loams and clays; the plasticity of clay; the formation of hardpan, and similar subjects.

These matters are exceedingly intricate and difficult to work out, but the vast importance of the economic problems depending upon these properties of soils justifies a prolonged and searching inquiry into them.

Several instruments and methods have been devised and perfected in the Division of Soils which are of distinct advantage in these lines of soil investigation. Furthermore, the very large and valuable collection of over 4,000 samples of soil supplies very valuable material for these laboratory investigations.

DIVISION OF AGROSTOLOGY.

NATIVE GRASSES.

It is acknowledged that there is no country in the world so rich in the number and variety of useful grasses and forage plants as the United States. The investigations of the Division of Agrostology have demonstrated that the country abounds in native species adapted to nearly every variety of soil and climate and to almost every requirement. There are upland and lowland varieties, there are woodland and prairie species, there are kinds which exist only in the humid regions along the coast, and there are others which thrive in the arid regions of the interior. Some are productive hay grasses or afford abundant grazing, while others again are valuable for fixing drifting sands or reclaiming impoverished or waste lands. There are decorative species for the garden or lawn, and not a few are useful in the arts and manufacture. Grasses are chiefly important, however, as food plants for all kinds of stock, yielding beef, mutton, and other animal products, which are a source of great wealth to the country, and their investigation along these lines is a most useful and essentially practical work of this Department. The fine quality of the forage afforded by the native grasses of our vast cattle ranges is a matter of world-wide comment; the perpetuation and improvement of the most valuable sorts are matters of extreme importance, and these may well be the subjects of practical scientific investigations at our hands.

COOPERATIVE EXPERIMENTAL WORK.

In addition to the continuation of the work already established in Texas, other experiments have been instituted during the year in the States of Washington and South Dakota. The results obtained in Texas clearly demonstrate the possibility of materially improving worn-out pastures and ranges by practical methods of treatment. Tests have been made of a number of promising drought-resistant grasses and forage crops, and some of these have shown great hardiness, as, for example, some of the saltbushes, sorghums, and vetches, as well as such native varieties as Colorado grass, blue grama, black grama, and wild rye. On the Pacific coast the most extended tests

have been made at Walla Walla, Wash. Among the varieties giving best results at this point may be mentioned sainfoin, Australian saltbush, blue grama, smooth brome, Oregon rescue grass, slender wheat grass, Japanese barnyard millet, Turkestan alfalfa, and some of the vetches. Most of these varieties show characteristics which will render them adaptable to the conditions which prevail over large portions of the great range regions of the West and Northwest. Thus, smooth brome has exhibited great vitality, surviving prolonged drought as well as extreme cold, and affording good returns of pasturage, hay, and seed under conditions that would destroy the ordinary grasses; the saltbush promises to be of much value on land strongly impregnated with alkali, and blue grama and the wheat grasses seem destined to become our most valuable means for reclaiming the many thousands of acres of range lands that have been all but ruined by protracted droughts and overstocking.

The work at Highmore, S. Dak., which is being carried on in cooperation with the State experiment station has for its object the testing of drought-resistant grass and forage crops, with a view to finding varieties suitable for the pastures, meadows, and ranges of the semiarid prairies east of the Rocky Mountains. Although but recently undertaken, the work is well in hand, and has already given results of practical value.

By means of these experiments we are learning that many of the native grasses adapt themselves readily to cultivation in our meadows and pastures, in some cases proving of more value than any of the introduced varieties yet tried. It is also being demonstrated that these native grasses are susceptible to improvement by careful cultivation and selection, and forms are being developed that give promise of much greater adaptability to farm conditions than the parent stocks.

There are many native leguminous forage plants, and some of these are also giving good results under cultivation. The Metcalfe bean of the table-lands of New Mexico is one of these. It not only does well in its native section, but has made excellent growth on the Pacific coast, and gives promise of being a valuable forage plant for the dry uplands of the West.

As in former years, most of the experimental work connected with the grass and forage plant investigations is carried on in cooperation with prominent farmers in various parts of the country, to whom seeds are sent for this purpose. During the year 1,600 packages of seeds, comprising 185 varieties of grasses and forage plants, have been distributed in this way. These seeds include choice varieties imported from foreign countries, in the hope that they will show special adaptability to the conditions which prevail here, and native sorts, collected by agents sent into the field to study the plants in their natural condition and to select those possessing characters of

particular value for cultivation. In this way it is being demonstrated that many of our recently introduced varieties are likely to have a wide range of usefulness, and that some of the commonly grown sorts deserve to be much more generally cultivated. Japanese barnyard millet is not only a most valuable crop for the New England States, but has given excellent results in many places in the South. Rescue grass has been grown in the South for many years, but many know little of its value as a winter forage or how to cultivate it. The legumes ought to be much more widely grown in the South, and will be when their great value, not only for food, but as restorers of nitrogen to impoverished soils, is more fully understood and appreciated.

GRASSES AS SAND AND SOIL BINDERS.

The large areas of drifting sands along the Atlantic, Pacific, and Gulf coasts and also about the Great Lakes and along some of our larger rivers, which, because of their unstable character, are a serious menace to life and property, could in many cases be reclaimed and converted into valuable pasture and meadow lands. The study of the grasses suitable for binding these sands has been extended along the Atlantic coast as far south as Florida, also to various points on the Pacific coast and along the Columbia River in Washington and Oregon. Several native sand binders of great promise have been discovered, and their utilization in a practical way has been undertaken. The seaside blue grass, a native of the sand dunes along the Oregon coast, where it grows abundantly, is said to be a good forage grass as well as an excellent sand binder, and has been successfully introduced along the sand dunes of Lake Michigan. The binding of drifting sands and embankments about fortifications along the coast is a serious problem which confronts the authorities of the War Department, and at their request some experiments have been made during the year on Tybee Island, at the mouth of the Savannah River. Here, as on the Pacific coast, one of the native grasses promises to be of greatest value.

THE GRASS COLLECTION.

Important additions have been made to the grass collection, including valuable material from abroad as well as from our own country. In all, 6,246 sheets of mounted specimens have been added to the herbarium and nearly 4,000 determinations have been made for correspondents.

PLANS FOR FUTURE WORK.

The great importance of the problems connected with the forage supply of our country—the close relation which it bears to the welfare and prosperity of the agricultural classes and the increase of public interest in grass and forage-plant investigations—make it imperative not only that the present lines of investigation should be continued,

but that new ones be undertaken. The investigations under way in the Gulf-coast region and on the Pacific slope ought to be extended in their scope; the work on range improvement should be continued along the present practical lines; the investigations looking toward the preservation and improvement of our most valuable native grasses and forage plants should be continued; the study of soil and sand-binding grasses ought to be extended to include experiments as to the adaptability of our native sorts to practical use for fixing the shifting sands of our coasts and for holding embankments in place, as well as to the introduction of desirable foreign sorts; investigations relative to the introduction, cultivation, and management of improved pasture and forage crops on the abandoned farms of New England should be undertaken; the question of forage crops suitable to alkali soils is one of much importance to certain sections of the country, and should receive full and careful investigation. There is no question as to the value and importance of investigations along all the lines indicated, and an increase in the appropriation for the Division is recommended in order to effectively carry on the work.

OFFICE OF EXPERIMENT STATIONS.

RELATIONS OF THE DEPARTMENT TO THE STATIONS.

The relations of the Department of Agriculture to the experiment stations of the several States become closer every year. An increased amount of assistance is given every year to the State experiment stations to enable them to carry out work of a national character. Cooperative work between the Department and the stations is gradually increasing. The Department is consulted oftener regarding the organization and management of the stations, the choice of officers, the lines of work to be undertaken, the execution of special work, plans for station buildings, materials and apparatus required for use in connection with the different kinds of agricultural investigations, etc.

The Department has been able to bring some influence to bear against the frequent change of station officials, which has been too common in certain States. At the same time no effort has been made to interfere with the independence of each as a State institution. The farmers of the States are appreciating the stations more and more, giving them attention, requiring better work, securing State funds, and interesting themselves in the management and supervision. This is having an excellent effect and resulting in better work for the communities in which they are located, all along the line.

NATIONAL AND STATE AID TO THE STATIONS.

The stations in all the States and Territories are visited regularly every year by officials of the Office of Experiment Stations, whose report is transmitted annually to Congress for the information of the national legislators. Where the experiment station is a part of the

agricultural college of the State the connection has a beneficial influence on the course of instruction, as the work of the station in the interest of the locality has a tendency to better instruct the officers of the college engaged in teaching. There is much need that the endowment of the Federal Government should be supplemented by the State in nearly every case, and many of the States are appropriating money to enable the stations to extend their work. The erection of buildings for the colleges has often been done for the purpose of increasing the facilities for experiment-station work.

The printing of station bulletins in a number of the States is regularly done at the public expense, while some of the stations are unable to publish the results of their experimental work for want of means for the purpose. Experimentation has been begun in Alaska with the aid of national funds. In each of the States of Alabama, Connecticut, New Jersey, and New York a separate station is maintained wholly or in part by State funds. The Louisiana experiment station, supported for a number of years by the sugar planters, is now under the management of the State. Every year the sum of \$720,000 is paid to the several stations by the National Government, while nearly \$500,000 is paid by the States, individuals, communities, and as fees for analyses of fertilizer, etc.

THE FUNDS OF THE STATIONS.

It has happened occasionally that boards of trustees have diverted experiment station funds to college purposes. The opinion of the Attorney-General of the United States has been had on this subject. According to this opinion, no portion of the funds appropriated by Congress in accordance with the terms of the act of March 2, 1887, can be used, either directly or indirectly, for paying the salaries or wages of professors, teachers, or other persons whose duties are confined to administration, teaching, or other work connected with the course of instruction given in the colleges with which stations are connected, or in any other educational institution, nor should any other expenses connected with the work or facilities for instruction in school or college courses be paid from said fund.

THE STATIONS CENTERS OF INFORMATION FOR LOCAL REQUIREMENTS.

In the development of methods of investigation and special apparatus the Department can now accomplish much more than any one of the stations. On the other hand, the stations are, to an increasing extent, becoming centers of information and authority on the lines of work in which they have been engaged with special reference to the local requirements of agriculture, and in some instances the stations, through the liberality of State governments or connection with strong colleges and universities, are in better position than the Department to carry on investigations requiring the knowledge and skill of experts or expensive forms of special apparatus.

By recognizing the authority of the stations in their several localities, securing the services of their expert officers, and the use of special facilities at their command, it is believed that the Department may oftentimes most economically expend the funds intrusted to it by Congress for special investigations, and can at the same time devote the energies of its officers more fully and effectively to the large enterprises for the promotion of the science and practice of agriculture.

THE EXHIBIT AT THE PARIS EXPOSITION.

An exhibit of the publications of the stations and of the Office of Experiment Stations, with photographs and charts showing the buildings and equipment of the stations, special features of their work, an illustrated report on the history of the stations, and a collection of special devices for station work, with illustrations of notable results by means of models and otherwise, will be made at the Paris Exposition. Investigations in Alaska, in nutrition, and in irrigation, in charge of the Department, will also be included in this exhibit. The materials for the exhibit will be largely furnished by the stations.

NEED OF STATIONS IN THE NEW POSSESSIONS.

There is a pressing necessity for the establishment of experiment stations in Porto Rico, Hawaii, and the Philippines. The newer and more intimate relations existing between these islands and the United States, the responsibility assumed by the United States regarding them, and the necessity for giving to the peoples of those islands information regarding their staple crops, their development, and the insect and bacteriological pests to which they may be liable, suggest the necessity of scientific investigation of everything pertaining to production. These stations will be needed in our island possessions much more than they are needed in our States and Territories. Special investigations along these lines will not take the place of permanent experiment stations.

There is no method of informing the tiller of the soil so valuable to him as to have practical scientists studying the conditions of production in his neighborhood. There is thus provided not only an object lesson, but the foundation of a farm literature. A local station should be placed in each of the groups, on land belonging to the Government, with buildings and equipments for field and laboratory investigations, for careful surveying of the agricultural capabilities and requirements of the lands, cooperative experiments with interested farmers, the dissemination under frank of bulletins of original and compiled information, and the holding of farmers' meetings in different localities for the diffusion of practical information.

In general, there should be a systematic effort to disseminate useful information on agricultural subjects among the people and to gain

new knowledge which may be utilized for the benefit of the agriculture of those regions. Educational influences of this nature established among the peoples of the islands will not be the least potent influences in elevating them to higher intellectual levels. Fifteen thousand dollars could be wisely appropriated for Hawaii, \$10,000 for the Philippines, and \$5,000 for Porto Rico. These stations for the present should be under the direction of the Secretary of Agriculture until such time as, under the benign influence of the United States, the people in the islands are thoroughly prepared to take charge of institutions of this kind and manage them for themselves.

INFORMATION REGARDING WORK OF THE STATIONS.

A series of Farmers' Bulletins, based on the work of the experiment stations, for the purpose of disseminating throughout the country information regarding the work of the stations, and thus to acquaint farmers in a general way with the progress of agricultural investigation, on its practical side, has been printed by the Office of Experiment Stations. The demand for this class of Farmers' Bulletins is growing very rapidly. The aim is to provide our farmers with a popular record of the progress of agricultural research.

WORK IN ALASKA.

Work is progressing in the establishment of an experiment station in Alaska. Prof. C. C. Georgeson, a thoroughly educated and practical experimenter, has been put in charge of the work. Headquarters for the present are established at Sitka, and a building is being erected there for the convenience of the scientists connected with the station work. Seeds have been distributed among different localities in Alaska, and measures instituted to obtain information regarding the crops, methods of cultivation, feeding of animals, and agricultural possibilities of the different regions.

Professor Georgeson is experimenting in the growing of different varieties of cereals, forage plants, flax, and vegetables in gardens placed at his disposal by citizens of Sitka. In spite of late planting, oats, barley, potatoes, flax, and a number of different kinds of vegetables of good quality were matured. Clover and grasses made an excellent growth. Useful data were also obtained from these experiments regarding the effect of different soil conditions on the germination of seeds and the growth of plants. Experiments similar to those being conducted at Sitka were made at Skagway.

Observations regarding soil temperatures are being made at Sitka and Skagway, and arrangements for similar observations will be made at other places. Samples of soil were collected at Sitka, at Kenai, and at Cooks Inlet, for which the moisture determinations were made under the direction of the chief of the Division of Soils in this

Department. Circulars of inquiry regarding the agricultural conditions in different parts of Alaska, including both the coast region and the interior, were sent out, and a number of replies were received and reported. A number of places on the coast region of Alaska have been visited and surveys and reservations of land for experimental purposes have been made at Sitka, Kadiak Island, Kenai, and Cooks Inlet.

Botanical investigations in Alaska under Dr. Evans, of the Office of Experiment Stations, have been carried on during the past year. A considerable number of specimens of the flora of the coast region were collected. Several species were found that may prove of considerable value as sand binders, for which there is great need in many localities of the United States.

Careful experimentation with grains grown in northern latitudes is being made. Efforts will be made by selection, and probably through the results obtained by crossbreeding, to find grains suitable for that territory. The effect of draining the soil is being tested, and the use of the silo for preserving stock feed is being demonstrated.

HUMAN NUTRITION.

Several bulletins on the subject of human nutrition have been issued by this Office during the past year. "The chemical composition of American food materials" (Bulletin 28, revised edition) contains the maximum, minimum, and average of 4,000 analyses of American food products, and gives a large number of analyses made since the first edition was issued. As a standard table of food analyses, it is, therefore, much more full and complete than any table which has preceded it. "Dietary studies in Chicago" (Bulletin 95), by W. O. Atwater and A. P. Bryan, contains a report on the food habits of fifty foreign and three American families in the congested west side of Chicago. "Fish as food" (Farmers' Bulletin 85) and "Sugar as food" (Farmers' Bulletin 93) contain a considerable amount of information derived from the reports on nutrition investigations mentioned elsewhere.

IRRIGATION INVESTIGATIONS.

BEGINNING OF THE WORK.

The first appropriation for irrigation investigations became available July 1, 1898. The literature of irrigation, especially that containing accounts of experimental inquiries, was collated and reviewed, and correspondence was had with experiment station officers, State engineers, and other experts who were devoting their energies to the study of irrigation problems in this country. A conference of station officers and engineers was held in Denver July 12 to 13, 1898, at which the needs of agriculture under irrigation were earnestly considered and

much valuable advice regarding plans for the work of this Office was obtained.

As a result of this preliminary inquiry, it was determined to limit the work of this Office under the appropriation to two general lines: First, the collation and publication of information regarding the laws and institutions of irrigated regions in their relation to agriculture; and, second, the publication of all available information regarding the use of irrigation waters in agriculture, as determined by actual experience of farmers and experimental investigators, and the encouragement of further investigations in this line by the experiment stations. Prof. Elwood Mead, State engineer of Wyoming, was asked to undertake the direct management of the investigations in charge of this Office. Two irrigation bulletins were completed within the fiscal year for which the appropriation was made. A report was also made to Congress on the usefulness of storage reservoirs as a part of the irrigation system. Thirty-five thousand dollars have been appropriated by Congress for the work of the present year, measures have been taken to organize the work on a more permanent basis, and an expert force with sufficient clerical assistance has been formed. The subjects requiring investigation are numerous. The conditions and needs of different localities vary, and the demand on the part of the people for more immediate information in so many lines is so urgent that much attention will have to be given to the selection of lines of work to be undertaken.

NEED OF EXPERTS.

One great difficulty is to find an adequate number of men who have had proper training to fit them to prepare publications or carry on investigations in the manner which our work requires. As a rule, the men who are best fitted for this work are engaged in other enterprises and can not be induced to enter the Department's service on the terms necessarily imposed. In this, as in other special lines of investigation which the Department has undertaken, it will be necessary to organize a force to work under the immediate direction of the expert in charge, and some time must elapse before this force can be thoroughly trained so as to perform the most efficient service. Considerable effort has been made to ascertain who are available candidates for positions in this service. The establishment of agricultural colleges for education in the sciences relating to agriculture has done something toward preparing scientists in several directions, but there are many lines in which very little has been done, and this is one of them.

When the Department requires soil physicists, plant pathologists, or scientists well informed regarding animal husbandry and irrigation, it has been found almost impossible to get them. The Western agricultural colleges, where scientific knowledge of the facts concerning

irrigation is most imperatively necessary, are making vigorous efforts to educate along these lines. The boards of management of the stations have been led to see the importance of the work in irrigation which the Department has undertaken, and are moving in the direction of the employment of a large number of competent investigators who can work in cooperation with the Department. There must be a period in which the training of experts, both by the Department and the experiment stations, will be the most important features.

REASONS FOR A GENERAL STUDY OF THE SUBJECT.

The need of an impartial and thorough study of water rights and the laws and methods of enforcing them is so urgent that the Department has been under continuous pressure from the people of the arid States to devote all the funds for irrigation investigations to this branch of the subject. The immense area embraced in the irrigated regions, the wide difference between the laws and methods of the different States, and the complexity and number of the problems to be considered have required the expenditure of a great deal of time and thought in the organization of this investigation. It is the intention, if sufficient provision is made, to include all the arid and semiarid States in this study during the coming year. In each of these States the law and methods differ widely. Even where conditions are of a similar nature, titles to water and methods of distribution are wholly unlike.

There is a second reason for making the investigation general. Many most important rivers are interstate streams. Some of them are used for irrigation in half a dozen different States. The water rights of these several States deal with a common supply. They vary so widely in their character that there must sooner or later come a time when their differences must be reconciled, or at least be brought to the attention of the Federal Government, and become a subject of legislation by Congress. It is of the utmost importance that before either of these things occurs there should be a thorough understanding of the character of the rights which are vested under these laws and of the disturbances which will ensue if a uniform or interstate system of water rights should be put in force. It is only through the collection and publication of these facts that either the several States or Congress can intelligently determine whether or not the control of rivers used in irrigation should be left exclusively to the States, as is done at present, or whether the present practice should be overturned and the streams be divided under the operation of federal laws and under the control of federal officials.

Measurements of the actual volume of water used in irrigation and the time of such use are being carried on in fifteen States and Territories. An approximate knowledge of the quantity of water required to irrigate an acre of land growing any given crop is sooner or later a

necessity in any irrigated district. Farmers, canal builders, water commissioners, State lawmakers, and Congress all need this information in the making of water contracts, the planning of works, and the determination and protection of rights in streams. Without it all these important transactions are largely based on conjecture. The mistakes to which this gives rise are a serious obstacle to the conservation of the water supply and its orderly division.

It is the purpose of this investigation to begin the collection of this information, but in order that it may have general acceptance and value the facts secured must embrace a wide range of conditions and crops and be continued through a series of years, in order that accidental variations of seasons may be eliminated. Before the investigation is ended it is expected that it will embrace a study of more economical methods and a determination of the extent to which the reclaimed area can be extended thereby; but at the outset it is desired to ascertain what is the common practice of irrigators.

The method of measurement adopted had to take into consideration the fact that the demands of crops are not the same during different seasons of the year, nor is the supply uniform. Streams rise and fall. The adoption of any device for delivering a uniform flow would not, therefore, meet the demands of either the users of water or the character of the supply. What has been done has been to provide for keeping a constant record of the amount used, without any regard to the intentional variations in use or the accidental changes in the supply. To do this it has been arranged to measure the depth of water passing over a weir or flowing through a flume, and from this record to compute the amount of water used.

One object of the studies on the duty of water is to secure greater economy in its use, the reclamation of an increased area, and a larger yield of crops through its more skillful application. Something more is necessary than measurement of the quantity employed. The factors which tend to produce a high or low duty must also be studied. These include the amount of rainfall, records of temperature, rate of evaporation, character of soil, losses in transportation in canals, the merits of different methods of distributing water over the land, and the influence which is exerted by the character of private water-right contracts for delivering water or of State laws governing titles thereto.

Before we can rightly estimate the value of reservoirs we must know not only the amount of water required by different crops, but the time when such water is needed. The purpose of reservoirs is to bring fluctuations in stream flow into harmony with the variations in the demands of crops. A dependence on the natural flow of many Western rivers permits of only a small fraction of their natural discharge being utilized, because the waters run to waste before or after they are needed. We must know when the water is needed, and how

much is needed in different months of the year, before we can rightly estimate how much must be stored in order to utilize the entire supply.

The character of water-right contracts has much to do with the economy or waste which prevails in irrigation. Many of these contracts have been prepared by people having little practical knowledge of the subject. Among the classes of contracts which have been productive of either discontent or abuses are, first, perpetual water rights. Under these contracts the user pays a certain amount per acre for all the land on the canal, whether he irrigates it or not. These contracts usually specify a certain duty which has been fixed before the needs of the lands or the crops to be cultivated were known. Sometimes this duty is so low as to be a direct incentive to waste; in others, so high as to be manifestly one-sided and unfair.

A second class of contracts comprises those for the delivery of the water used at a specified rate per acre, without regard to the economy or waste of the irrigator. These contracts lead to controversies, because of the temptation on the part of the irrigator to use all he can, regardless of his necessities, since in that way he gets more for his money; while on the part of the canal owner the temptation is to agree to provide water for as many acres as he can without regard to his ability. The objections to these two classes of contracts are leading to the evolution of a new system in which payment is made for the quantity of water used.

The usefulness of this investigation is not limited to the arid region. On the contrary, there is no question but that irrigation can be profitably employed in the cultivation of large areas in the Eastern and Southern States. A hundred thousand acres of sugar land are being irrigated in Louisiana. Irrigation of the rice fields in the Carolinas is very extensive. The market gardener could profitably use irrigating waters. Irrigation is being experimented with in the growing of tea in South Carolina. Prof. E. B. Voorhees, of the New Jersey Agricultural Experiment Station, is collecting data on the area of land now irrigated in that State, the methods employed, the duty of water obtained, and the benefits received.

Many of the valleys of the mountain States are being injured seriously by the injudicious use of water. Wherever the soil contains alkali, it is being brought to the surface when too much water is applied, and the land thereby rendered infertile.

More than one-third of the country depends upon the success of irrigation to maintain the people, the industries, and the political institutions of that area, and future growth will also be measured by the increase of the reclaimed area. In a region which, in the extent and diversity of its mineral wealth, has no equal on the globe, the riches of the mines in the hills are already surpassed by the productions of the irrigated farms in the valleys, and the nation at large

is at last awakening to the fact that the development of the use of the rivers and arid lands of the West will constitute one of the most important epochs in our increase in population and material wealth.

It is not possible at the present time for the owner of an irrigated farm to know exactly what his right is. The nation has made no provision for the distribution of either the natural flow of the streams or the stored water. The States vary greatly in their enactments regarding the use of water. If the control of this element of production is to be left to the States, there should be a definite declaration to that effect. If it is to be assumed by the General Government, it should be done at once.

OFFICE OF PUBLIC ROAD INQUIRIES.

INQUIRIES REGARDING ROAD-MAKING MATERIAL, ETC.

Something has been done during the past year by the Office of Public Road Inquiries to ascertain what can be accomplished in making roads by the use of the material found in the several States. Cooperation has been had with the experiment stations of several States in making steel roads, macadamized roads, and gravel roads. The people of all the States are very much interested in the improvement of their public highways. There is a great demand upon the Department of Agriculture for assistance in road making, in addressing the students at our agricultural colleges, and in giving instruction regarding the best methods of using what material may be found convenient. Publications have been sent out from the Department covering the several features of road making, and for these there is great demand. Much attention is being given to this subject by the legislatures of the several States of the Union.

I am of the opinion that it would be wise to have the resources of the Eastern, Southern, Middle, and Western States carefully inquired into by the appointment of competent men in each of these sections who would ascertain and report upon the road-making material obtainable, and at the same time give instruction in the actual construction of roads. There is also a necessity for scientific inquiry into the composition of road material in the several sections of our country, and the facility with which these materials when brought together combine to make good highways. Many sections of our country have within reach hard rock from which good roads can be made. Other sections are entirely lacking in this regard, and must, in my opinion, eventually look to steel tracks for supplying permanent good roads.

In order to get information along these lines, short sections of steel track were laid during the past year at Omaha, Nebr., Ames, Iowa, and St. Anthony Park, Minn. The Western States are not well supplied with stone and gravel for road-making purposes, and the people of these States are watching these experiments with great interest.

It is our intention to encourage the laying down of steel-track sections during the coming year wherever we can induce the localities to purchase the steel. We do not yet know what is the best shape for the steel rail, nor do we know the best material to lay between the tracks, but inquiry is being made along these lines and information is being gathered from experience.

The people of the United States have associated themselves into national and State organizations for the purpose of encouraging the building of better roads and for the consideration of ways and means to that end. There is a great deal of agitation and considerable education along road-making lines. The people of many localities are exceedingly anxious to have the cooperation of the Department in improving their roads, and demands of this kind are so numerous that our limited force is entirely inadequate to give the assistance required. The object-lesson road work of the year has been as extensive in territory covered as it has been far-reaching in results accomplished. Model roads of various kinds have been built, under the supervision of agents of the Office of Public Road Inquiries, in Maryland, Nebraska, Minnesota, Iowa, Kentucky, Indiana, and Wisconsin. Elementary knowledge of road making is being rapidly spread among the people. Students at our colleges are taking a great interest in the study of road making. Gentlemen of means, enterprise, and public spirit are doing much along experimental lines for the education of their neighbors.

PRINCIPAL INQUIRIES OF THE YEAR.

The principal inquiries during the year were upon the following subjects: New road legislation, especially as regards State aid; the use of convict labor in road building or in the preparation of road material; experiments with steel roads and other new plans; methods of raising road funds; conditions of new roads under wear, especially the sample roads designed by officers of the Office of Public Road Inquiries; the promotion of rural free delivery of mails by good roads; the progress of organizations for road improvement; the prospects for road construction in several localities. The invention of road graders for use in the great productive prairies of the West has simplified the construction of roads more than any other one feature of progress. The value of these graders in making roads by horsepower is not well understood in all parts of the United States.

RECOMMENDATION.

The great activity on this line among the people of the United States during this fall, and the necessity of getting facts for use in the several localities of our country, induce me to recommend that Congress increase the appropriations of this Office sufficiently to justify the appointment of four experts, so that information can be

gathered regarding valuable road material and cooperation be had with experiment stations, colleges, and universities, and with the men of enterprise who are now actively seeking such information and such assistance.

DIVISION OF PUBLICATIONS.

NUMBER AND COST OF PUBLICATIONS.

During the year 603 different publications were issued, aggregating 26,420 pages of printed matter, and the total number of copies was 7,075,975, greatly exceeding the work of any previous year. Of this number, 176 were Farmers' Bulletins, of which 2,437,000 copies were printed and distributed. The cost of printing these publications was \$91,966.59, and of blanks, blank books, etc., \$36,624.93, making the amount expended for this purpose \$128,591.52. There was paid for artists and illustrations, labor and materials in connection with the distribution of documents, and for artists' supplies, \$29,836.55, making the total expenditures under the supervision of the Division of Publications, exclusive of the amount appropriated for statutory salaries, \$158,428.07.

In this connection, it may be said that the care and prudence which have characterized the management of the Department printing are strikingly manifested by a comparison of the number and cost of the publications since the period when the Division was first established. In 1891, the first year when the Division was fairly organized, there was expended for actual printing 59.8 per cent of the total appropriation for that year, while 40.2 per cent was expended for editing, illustrating, and distributing, whereas in 1899 of the total appropriation for printing only 27.1 per cent was absorbed for editing, illustrating, and distributing, leaving 72.9 per cent available for actual printing. Thus, in 1891, when the total appropriation was \$87,600, the number of copies of publications printed was 2,348,447, while in 1899, with total appropriations of \$185,260, the number of copies of all publications printed was 7,075,975, showing a proportionate excess of at least 2,000,000 copies in the actual output of printed matter in 1899 over 1891.

FARMERS' BULLETINS.

Of the total number of copies of Farmers' Bulletins printed (2,437,000), Senators, Representatives, and Delegates in Congress took 1,101,985—considerably less than last year and the year previous. Under the law, when Senators, Representatives, and Delegates do not avail themselves of the entire number of Farmers' Bulletins allotted to them, the same revert to the Department for miscellaneous distribution or for satisfying further Congressional orders. I am therefore able, for the current year, to increase the quota of Farmers'

Bulletins allotted to Members of Congress from 4,000 to 5,000 copies. During the year 22 new Farmers' Bulletins were issued and 154 of those heretofore published were reprinted. Most of the bulletins of this series are of permanent value, and are therefore suitable for continuous distribution. It is my intention to still further increase this series by adding to it bulletins upon such subjects as the people seem to require information, and to give the same the widest possible distribution. The total number of Farmers' Bulletins issued since the series was inaugurated up to the close of the fiscal year ending June 30, 1899, was just 100, and the total number of copies printed was 11,270,500, of which Senators, Representatives, and Delegates in Congress have received and distributed 6,851,752.

MISCELLANEOUS PUBLICATIONS.

Of publications other than Farmers' Bulletins, 427 were prepared in the various Bureaus, Divisions, and Offices of the Department. As usual, these bulletins, many of them scientific or technical in character, have been distributed as judiciously as possible, the effort being to place them in the hands of those only to whom they will be of special interest and value, and to prevent waste or duplication. I regret that under the law the editions of some of the most valuable of these bulletins are restricted to 1,000 copies, so that the important information they contain can not be given the wide dissemination it should receive. It is earnestly hoped that this unwise restriction may be speedily removed, so that there may be no obstacle to the distribution of publications for which an urgent demand exists. It is interesting to note in this connection that during the year the Superintendent of Documents sold 18,750 copies of the publications of this Department, which had been turned over to him under the law, constituting 70 per cent of all the public documents disposed of by him during that time, thus indicating that there is a considerable number of persons to whom the small price affixed by the Public Printer is no obstacle to obtaining publications in which they are interested.

THE YEARBOOK FOR 1899.

The Yearbook for 1899 is now in course of preparation and is modeled in accordance with the plan suggested in my last report. It will contain a résumé of the achievements in the United States in every branch of science related to agriculture during the nineteenth century, and it is hoped that Congress will see the propriety of ordering an extra number, say 20,000, for distribution at the Paris Exposition in 1900. In connection with our agricultural exhibit, the distribution of special-bound copies of this publication would serve the useful purpose of acquainting foreign countries with the achievements in agriculture in the United States.

AN EVIDENCE OF THE DEPARTMENT'S USEFULNESS.

This steady and rapid growth in the publication work is a most gratifying indication of the success of the Department in fulfilling that section of the organic law creating it which makes it an essential part of its duty to diffuse information among the people on subjects relating to agriculture. Brief, popular pamphlets continue to afford the most acceptable means of widely disseminating the results of the Department's investigations, while the scientific and technical publications, still considered as standard works of reference and authority by scientists both in this country and abroad, are accorded their deserved prominence in libraries and institutions of learning. The people have a right to look to this Department as the highest authority on every subject connected with agriculture, and the number of publications issued which are designed to supply the information requested, as well as the very wide distribution given to them, is a most satisfactory indication that the Department is occupying the place intended for it in the machinery of the General Government.

THE LIBRARY.

GROWTH OF THE LIBRARY.

Additions to the Library during the past year have numbered about 4,000 volumes, including some very rare works and scarce sets of periodicals. The periodical list of the Library is growing very fast, owing to the efforts made to increase our exchange lists with publishing scientists and the officials of various countries. There are currently received by the Library at the present time nearly 2,500 periodical publications, more than 1,800 being obtained by way of exchange and gift. The care of this mass of literature is becoming a more and more serious problem in the limited room at the disposal of the Library.

CATALOGUES.

The card catalogue during the four and a half years since its inception has grown enormously. There are now more than 50,000 cards in the catalogue, covering, in author and subject entries, more than two-thirds of the books in the Library. The publication of a catalogue of books on forestry has shown that the collection on this subject is extremely full, having undoubtedly more than three times the extent of any other similar collection in this country. Catalogues of the books on botany and chemistry are well advanced and will probably be published before the end of next year. There is also in progress a complete author and subject catalogue of the publications of the Department of Agriculture since 1839, with such analytical entries as will bring out the subjects of separate papers in publications like the Yearbook and the Farmers' Bulletins.

DEMAND FOR THE PUBLICATIONS OF THE DEPARTMENT.

The demand for the publications of the Department is increasing at home and abroad very rapidly. They are attracting great attention among the learned men of foreign countries. We receive in exchange for them a large proportion of the valuable agricultural publications of all countries, and every attempt is made by correspondence to increase the material obtained in this way.

DIVISION OF ACCOUNTS AND DISBURSEMENTS.

For the fiscal year ended June 30, 1899, Congress appropriated for the Department of Agriculture \$2,829,702. By the same act \$720,000 was provided for the 48 agricultural experiment stations. The total expenditures for the year amounted to \$2,797,173.49. The unexpended balances were covered into the Treasury.

SECTION OF FOREIGN MARKETS.

INQUIRIES REGARDING FOREIGN TRADE.

Our heavy foreign trade within late years has attracted much attention, both at home and abroad. Numerous inquiries have been received regarding the commercial opportunities offered by the former Spanish possessions. No authority has been given to this Department to get exact information regarding trade facilities in Porto Rico, Cuba, and the Philippine Islands. The Section of Foreign Markets, has, however, collated and published everything available regarding the trade of those islands. Frequent inquiry comes regarding trade in China and Russia, which seem to offer great commercial possibilities in the immediate future. There is a dearth of reliable information regarding both these countries.

REPORT ON THE TRADE OF THE PHILIPPINE ISLANDS.

The report by this Section on the trade of the Philippine Islands required an unusual amount of research. It was found that the statistics from Spanish sources were meager and gave a very inadequate idea of the commerce that belonged to these islands. The Section has also printed a report dealing with the agricultural resources of the islands, especially plant products, to meet the great demand for information on this subject. The report contained a general description of the most important Philippine cereals, vegetables, roots, fibers, dye plants, etc., supplemented by statistics of production, price, and exportation.

AGRICULTURAL EXPORTS AND IMPORTS.

The record for 1898 shows that our agricultural exports were decidedly the largest in the history of the country. Their total value reached \$858,507,942. Among the exports that showed the largest

gains were wheat and wheat flour, corn, oats, rye, bacon, lard, hams, cotton-seed oil, and oil cake. It was found that there was a falling off in the agricultural imports, the total value being \$314,291,769, which was \$86,579,672 less than the year previous. The decline in agricultural imports for 1898 amounted to 22 per cent. Sugar and wool were the principal factors that marked this falling off.

STUDY OF DANISH IMPORTS FROM THE UNITED STATES.

A study of Danish imports from the United States shows that that country was importing in considerable quantities some of the articles that enter most extensively into its export trade—butter and bacon, for example. The Danes, having established a profitable market for butter and bacon abroad, sell their own and buy from us. It is not well established, however, that they do not import American farm products for reexport under local names. We know that American bacon is heavily imported into Ireland and sold in England as Irish bacon. We have also information from agents abroad that the thrifty people of that country (Ireland) import well-bred American horses and sell them to the English, in many cases, as Irish hunters.

American wheat flour is competing in Denmark with the home product. During the fiscal year 1898 our shipments of this article to Denmark amounted to 61,019 barrels, more than 20,000 barrels in excess of the largest shipments previously sent. The Danish bakers find that the American flour is as good as the best Hungarian, although less expensive, and it is being generally substituted for the latter. The milling industry of Denmark is declining. Every indication points to an increase in the amount of flour imported from the United States.

The American farmer is furnishing cow feed to the Danes. They imported 16,874,943 bushels of indian corn in 1898. This, in addition to the more nitrogenous mill feeds imported, enables the Danish farmers to supply the British markets with some thirty-three million dollars' worth of dairy products every year. The growth of the dairy industry in the United States indicates that before many years the American farmer will feed his cow feed at home and sell the product of his skill in foreign markets. The Danes bought 55,958,939 pounds of oil cake from the United States in 1897, and in 1898 they bought 155,121,048 pounds. The American farmer can not afford to export the nitrogenous by-products of the mills, as the soil that grows them is regularly reduced by taking them from the farm.

In this connection, it may be interesting to state that butter made in Denmark from these American imports is peculiarly well adapted to the markets of tropical countries. The butter has a higher melting point than butter made from the wider carbonaceous ration generally used in the United States. We raise linseed in the United States to get the oil with which to make paint for our buildings, but

have not learned that the nitrogenous by-product is of the first importance in feeding live stock, especially the dairy cow. We are also shipping considerable quantities of bran, and the trade is growing in these nitrogenous exports.

The Danish farmer is enabled to furnish the markets with the finest possible product, and at the same time maintain the fertility of his acres. The Danes are reclaiming waste lands through the use of fertilizers resulting from the purchase of our nitrogenous by-products. We are reducing our lands to sterility by selling these products. It is the duty of this Department to assist the farmers of the United States to find markets for all their surplus products. It is also our duty to warn them of the consequences of exporting stock feed to foreign countries. The Danes have developed a heavy export trade in some of the products of the farm, and the secret of their success lies in the great pains they take to cater to the particular requirements of the foreign consumer and the care they exercise to maintain the uniform high standard of their products.

Not only is every precaution taken to prevent the exportation of inferior or damaged articles, but sufficient attention is always devoted to the packing and methods of shipment to insure arrival in good condition of the articles exported. We exercise no supervision over the shipments of American dairy products. The foreign buyer can depend upon the character of the consignments received from the Danes, but unscrupulous traders in the United States devote their utmost energies to imitations of our best dairy products. Some years ago we had an excellent market in Great Britain for our cheese, whereupon a spurious article was exported that destroyed the good name of American cheese. This is being done now with regard to American butter.

Copenhagen is the natural distributing center for the trade of the Baltic Sea, and it has established a free port for the transshipment of merchandise billed to other destinations. The amount of American merchandise distributed through the Baltic region is increasing very rapidly. During the fiscal year 1898 our direct shipments to these Scandinavian countries amounted in value to more than \$25,000,000. Although agricultural products form a large part of this item and show a material gain for the past decade, the principal increase has occurred in our shipments of manufactured wares, such as machinery, tools, utensils, etc.

Ten years ago the annual value of the exports of manufactured articles from the United States to the Baltic countries did not exceed \$3,000,000. It now amounts to \$10,000,000. Meanwhile the annual value of our agricultural exports to the same region has risen from less than \$10,000,000 at the beginning of the decade to about \$15,000,000 at its close. As long as the United States produces the cheapest cow feed in the world for export, the market for agricultural products will

grow in the Baltic countries. Our best opportunity in this region, however, lies in the development of a wider demand for our manufactures, of which the prospect is excellent. Transshipment at Copenhagen for other Baltic ports is a blunder on our part. American ships should take goods to their destination under the American flag in all parts of the world.

WORK OF THE SECTION IN FURNISHING INFORMATION.

One of the most useful features of the work performed by the Section of Foreign Markets is the furnishing of information to American citizens all over the country regarding these lines of industry. These inquiries are very extensive. Pamphlets have been prepared, and others will be, covering the information in most general demand, and at a time when the products of our fields and factories are so much beyond the requirements of home markets, the work of this Section is peculiarly valuable.

BUREAU OF ANIMAL INDUSTRY.

NUMBER OF ANIMAL INSPECTIONS AND COST.

The report of the chief of the Bureau of Animal Industry for the last year shows that the work carried on by the Bureau is increasing rapidly from year to year, and is becoming more and more an important factor in the economy of animal production and in the exportation of animal products. Meat inspection was conducted during the last year at 138 abattoirs in forty-one cities. The total number of antemortem inspections of animals was 53,223,176, of which 34,405,973 were for official abattoirs and 18,817,203 for abattoirs in other cities and for miscellaneous buyers. The number rejected upon this examination was 156,539. The growth of this feature of the work is shown by the fact that in 1892 the total antemortem inspections for official abattoirs was only 3,809,459. The total number of post-mortem inspections was 34,163,155. The cost of this inspection was \$465,709.23. The cost per head on antemortem inspection was 0.88 cent; in 1892 the cost per head was 4.75 cents, and only once was it less (0.8 cent).

The number of hog carcasses examined microscopically was 2,227,740. Of this number, 2,160,230 were free from all appearance of trichinæ and 25,913 contained only trichinæ-like bodies, while 41,597, or 1.87 per cent, contained living trichinæ. The exports of this pork to countries requiring inspection amounted to 108,928,195 pounds, while only 70,046 pounds went to countries not requiring inspection. The cost of this work was \$198,355.14, or 8.9 cents for each carcass, and 0.182 cent for each pound exported.

There were inspected for export 436,595 American and 67,688 Canadian animals. The number of inspections of vessels for carrying

export animals was 852. Of the cattle exported to Great Britain, the losses were but 0.31 per cent; of sheep, 1.54 per cent; of horses, 1.11 per cent.

The expense of inspection of animals for export, the supervision of the movement of Southern cattle, and the inspection of animals imported from Mexico amounted to \$107,023.31. It is estimated that the cost per head of inspecting cattle and sheep for export averaged 13 cents. During the quarantine season of 1898 there were unloaded at stock yards north of the infected area 911,455 quarantine cattle, and there were inspected in the noninfected area of Texas 236,369 cattle for shipment into other States for grazing. The imports from Mexico requiring inspection at the boundary line were 79,908 cattle, 1,254 sheep, 64 hogs, and 121 goats. The imports from Canada, not subject to quarantine, were 90,468 cattle, 172,985 sheep, and 1,769 horses. Some of these were for breeding, but the large majority were for feeding purposes. The total number of animals received at the ports of import was 2,463.

All of this work was done to prevent the spread of disease among the animals of the United States, to protect consumers from diseased meats, to secure the arrival of our animal products in foreign markets in good condition, and to maintain the reputation of those products at home and abroad.

LOSS FROM BLACKLEG.

According to the latest report, it is estimated that the annual loss of cattle from the disease known as blackleg, or symptomatic anthrax, in the districts principally affected has ranged from 5 to 35 per cent. The Bureau of Animal Industry has been for some time distributing a vaccine for the prevention of this disease, and this, it is estimated, has reduced the loss to 0.54 per cent among the animals treated. As it is known that a large percentage of this loss was due to careless operators, it is believed that with more care in the use of the vaccine future investigations will show a still further reduction. Vaccine is still being sent out, and during the fiscal year 545,289 doses were distributed. The indications are that the contagion gradually dies out where systematic inoculations are practiced, and it was with the hope of eradicating the disease from many sections that the preparation of vaccine was undertaken.

TEXAS-FEVER INVESTIGATIONS.

The experiments of the Bureau demonstrated that Northern cattle might be made immune from Texas fever by inoculating them with the blood of immune animals. This has recently been adopted and practiced with most satisfactory results by some of the experiment stations. The practical application of this discovery is of great

importance both to the breeders of improved stock in the more Northern States and to the cattle raisers of the infected district, as it permits the improvement of Southern herds without the discouraging losses that have heretofore always occurred.

Experiments have been continued with a view of obtaining a mixture in which cattle from the Texas fever districts may be dipped for the destruction of the ticks which spread the disease, and which at the same time will not injure the cattle. This effort has not been entirely successful, but the progress of the work heretofore leads to the hope that such a mixture may be found. The difficulty in finding such a mixture is plain to those who know how tenacious of life is the tick which is the carrier of this disease.

Investigations in Porto Rico show that the cattle tick is prevalent there, but the ticks which were brought from there and placed on cattle in the United States failed to produce Texas fever. Whether this result was accidental or whether these ticks are without infectious properties is a question of great importance. If further investigations show that the Porto Rican tick is free from the *Pyrosoma*, the true contagion of the disease, and that the cattle of Porto Rico are susceptible, the introduction of a single animal bearing the *Pyrosoma* might convert these comparatively harmless parasites into the most deadly scourges of the bovine race. This subject will receive further attention during the current year.

TREATMENT FOR HOG CHOLERA.

The preparation of serum for treating hog cholera and swine plague has been on a very much larger scale than last year, and the results are exceedingly satisfactory. The diseased herds in four counties of Iowa have been under treatment, the results showing a saving of from 75 to 80 per cent of the animals injected, though the final reports are not all received at this writing. It is evident, however, that this method of treatment is far in advance of any other heretofore tried.

SHEEP SCAB.

For many years the parasitic disease of sheep popularly called scab has been quite prevalent, especially among the flocks of some of the Western States and Territories. Diseased sheep have been shipped from one State to another in violation of the law, and the stock yards and stock cars have been almost continually infected. The result of this condition has been that sheep could not be purchased for feeding purposes in any of the markets of the country without danger of bringing to the farm with them the contagion of this disease.

Sheep scab has been one of the greatest evils which the sheep industry has had to contend with. Not only does it always damage and often destroy the fleece, but it reduces the strength and condition of

the affected animals so much that they fall an easy prey to internal parasites or succumb to unfavorable conditions of food and surroundings. Congress has specifically referred to this disease in the appropriation act as one of the diseases which the Department is authorized to control by sanitary regulations.

The first step taken by the Department looking to the limitation and control of this disease was the issuance of a circular letter notifying transportation companies and shippers of the existence of the contagion, and pointing out the prohibition of shipment and the penalty provided by law. Subsequent to this an order was issued that diseased sheep discovered by the inspectors in the channels of interstate commerce should be detained and dipped before going on to destination; also, that sheep purchased in infected yards for feeding should be dipped before they were allowed to go to farms. The effect of these orders was to protect the purchasers of store sheep and to lessen the number of diseased animals sent to market. It was found, however, that some of the dips used by the stock yards, companies, and owners of sheep were not efficacious under the conditions which obtain in this service, and that others were so severe or poisonous as to be dangerous. An order has, consequently, been issued specifying the kinds of dips which would be recognized and the manner in which these should be prepared and applied.

The effect of these measures has been extremely satisfactory, and the number of diseased shipments received at the principal stock yards have been very materially decreased. This has been accomplished without putting the shippers of healthy sheep to any inconvenience or expense unless the animals were going to farms from infected stock yards. The inconvenience of detention and the expense of dipping have had an excellent effect in lessening the number of diseased sheep sent to market, and has led to active efforts everywhere to cure them on the farm or ranch before shipping. The indications are at this writing that it will soon be possible to make the stock cars, the central stock yards, and other channels of interstate commerce safe and free from infection, in which case store sheep could be purchased in the markets without danger of infection, and only diseased sheep would come under the restrictions.

EXPERIMENTAL EXPORTS OF DAIRY PRODUCTS.

The experimental exports of dairy products made during the last two years and now in progress under special provision of law have produced marked results. But these are not satisfactory in all respects and the reputation gained needs to be protected by authority from Congress for some system of export inspection. The new markets opening for our dairy products require a guaranty of the purity and quality of butter and cheese sent from the United States, such as is given by other Governments, and especially Canada.

Not long ago this country supplied and practically controlled the cheese market of Great Britain. In some years we sent to England nearly 150,000,000 pounds, or two-thirds of our entire cheese product. But as no system of export inspection existed to guard the established reputation, unscrupulous merchants exported great quantities of inferior, adulterated, and counterfeit cheese, until the reputation of States cheese was destroyed in England, and that market lost to us. Canada, on the other hand, adopted a system of government control, was enabled to guarantee all cheese exported as pure and of standard quality, and thus secured, and still holds, the desirable British cheese trade which this country lost. We have recovered a little, but only a little, of the lost ground. The best cheese now exported from this country goes through Montreal, seeking the same avenues and the good company of Canadian cheese, finding a market virtually as a part of that product.

The same unfortunate result seems likely to follow the efforts to export fine creamery butter to Great Britain unless measures are promptly taken to avoid it. An active demand has arisen for this butter especially in the northern counties of England, supplied from Manchester, largely through the experimental efforts of this Department. During the summer of 1899 an exceptional scarcity of European butter caused very high prices, and British merchants sent large orders to New York. In the month of August our butter exports were six times as great as for the same month a year ago. This new and profitable demand for fine creamery butter had scarcely begun, however, before large quantities of an inferior article and also of imitation creamery, "process," or renovated butter, began to appear among the exports.

This article, which is a more dangerous and damaging counterfeit of fresh creamery butter than straight oleomargarine, was sent to New York by the carload for export. In at least one instance parties had renovated butter put up in the West, in the style of package adopted by this Department in its recent export trials to England, and this went abroad labeled "Finest American creamery butter." The effect of this upon future butter trade with Great Britain will probably be like that which followed the export of so much unidentified filled cheese. Already English merchants, who have been trying to introduce States creamery butter among their customers, have written to this Department complaining of the deception practiced upon them.

Out of six large lots of butter received by one firm at Manchester from the United States, all represented as "extra creamery" goods, five were rejected as being far inferior to the quality represented—apparently only poor imitations. Meanwhile Canada is forging ahead, with government supervision and guaranty to assist, and

securing for its creamery butter a firm hold in the British markets. The lack of some protection by Government certification of exports from this country is already causing butter shipments by way of Canada, as in the case of cheese, previously mentioned. British merchants state that some of the best States creamery butter they have lately seen (as shown by makers' marks) has been among lots received from Canada.

I recommend, as a simple and effective remedy for these growing evils and obstacles in our export trade, that the existing system of Government inspection and certification of meats and meat products for export be extended by law so as to include butter, cheese, and condensed milk and cream. With slight modifications the organized force and regulations which now give protection and standing to our meat exports may be made to cover the new work proposed. The services of an inspector who is an expert in butter and cheese would be necessary for parts of the year at three or four exporting points; but until these exports increase New York would be the only place at which such an inspector would have to be continuously employed.

If such inspection and certification is authorized by Congress, the pure and unadulterated dairy products of the United States that are of a quality entitling them to official indorsement can be given a position in foreign markets which they can not otherwise secure, and which will enable them to compete successfully with like products from any other country.

This inspection of dairy products for export has been indorsed by nearly all the national and State dairy organizations in this country and has met with decided approval by commercial bodies and by individual exporters wherever it has been duly considered.

DIVISION OF STATISTICS.

INVESTIGATIONS DURING THE YEAR.

The condition of the agricultural industry, as indicated by the area of land devoted to the cultivation of the principal products of the soil; the actual volume of production and the value of particular crops, both on the farm and in the principal markets; the cost of production per acre and per unit of quantity and the cost of transportation; the number and value of farm animals and the losses annually resulting from disease and exposure; the volume, condition, and prospects, according to the season of the year, of such of the crops of foreign countries as compete with those of the United States in the world's markets, have constituted the field of investigation in which this Division has been engaged during the past year.

STATISTICAL REPORT.

Of the regular periodical reports of the Division there has been printed a total of 1,621,700 copies. These reports cover that general work of the Division which is continuous in its operation and which has constituted for a generation or more the only source of information available to the farmer that has been comprehensive, prompt, and unbiased.

THE CROP-REPORTING SYSTEM.

No change of essential or far-reaching importance has been made during the year in the methods of collecting agricultural statistics, but there is a marked improvement in all the different agencies employed, the monthly reports being more complete, giving evidence of greater care in their preparation, and generally displaying a more intelligent conception of the requirements of the Department on the part of its correspondents.

At the end of the fiscal year the organization included 41 salaried State statistical agents, with 8,730 correspondents, upon whose reports their monthly statements were mainly based; 2,627 county correspondents, with 7,881 aids and 36,426 township correspondents reporting each for his own immediate neighborhood. From this large body of persons—selected with great care, not only as to their geographic distribution, but also as to their qualifications for the performance of the duties required of them—reports have been received monthly, and at the close of the calendar year a select body of farmers, numbering about 90,000, reported upon the crops of their own individual farms. The Department is indebted to numerous transportation companies for monthly returns of cotton carried over their respective lines, information which has been of the greatest value in the making up of its final returns on the production of cotton.

No important change in the crop-reporting system will be recommended until the approaching federal census shall have furnished the Department with a new and definite statistical basis as to the distribution of crop areas. The Department's system is based, in the main, upon a periodic comparison of the acreage devoted to particular crops with that so used in the preceding year, and it is consequently not only impossible to make any increase, during the closing years of an intercensal period, in the number of products reported upon, but it is difficult, even as regards those which are reported upon, to keep exact step with a fluctuating acreage and a constantly varying production when the cumulative effect of even a small annual error in a report based on percentages may reach large proportions.

A PUBLICATION FOR CROP CORRESPONDENTS.

Much of the improvement so gratifyingly in evidence in the reports of correspondents is doubtless attributable to the issue of a new monthly publication known as "The Crop Reporter," designed for

the exclusive use of the Department's crop correspondents. The necessity of compressing into very small space the instructions printed upon the monthly reports, the marked localization of the area of production in the case of not a few of the crops reported upon, and the general lack of uniformity in the agricultural methods and conditions obtaining in the different sections of the country have alike suggested the employment of some agency by which correspondents could be more fully instructed as to their duties and the instructions given them be better adapted to their various needs.

Such an agency has been found in the new publication, which has been received with many expressions of satisfaction by correspondents in every part of the country. By anticipating their needs, interesting them in their work, making intelligible to them the relation which, as individual correspondents, they bear to one of the most important branches of the work of the Department, and putting into their possession, without trespassing upon the province of the agricultural journals, a great variety of information calculated to make them better judges of agricultural conditions, and consequently more valuable correspondents to the Department, "The Crop Reporter" has been the means of greatly improving the crop-reporting service, while incidentally reducing the enormous correspondence of the Division by nearly one-half.

SEED DISTRIBUTION.

COST OF DISTRIBUTION AND FAVORABLE REPORTS RECEIVED.

An appropriation of \$130,000 was made by Congress for the purchase and distribution of valuable seeds, etc., during the year 1899. Of this sum, there was expended for the purchase of seeds for distribution through Members of Congress \$70,978.36. For rare and valuable foreign seeds distributed by the Section of Seed and Plant Introduction, under the Division of Botany, \$20,300.92 was expended; for the purchase of sugar-beet seed distributed to experiment stations and individuals, \$2,366; for seeds and bulbs distributed to Members of Congress through the Division of Gardens and Grounds, \$3,400, and for seeds distributed for special investigation by individuals in the several States, \$3,000. There was paid for salaries of employees connected with the seed distribution \$25,912.98, and for miscellaneous supplies in connection with the work, \$221.85. There are some outstanding vouchers for freights, etc., not yet adjusted.

The contractor was required to provide a building within the City of Washington in which to pack the seeds, and samples were tested by the Division of Botany for purity and germination. The high quality of the seed now being sent out by the Department is scarcely equaled by any of the distributing agencies of the United States. Of 979 letters received regarding the seed distributed, 972 report favorably upon the quality.

AIM OF THE DEPARTMENT IN THE DISTRIBUTION OF SEED.

The original intention of Congress in providing for the distribution of seed undoubtedly was to do for the producers a class of work they could not do for themselves—to search the various localities of the Old World for seeds and plants, and distribute them in the United States to the several regions where they would be most likely to succeed. The Department at present is endeavoring to bring back the practice, as much as possible, to the original intention of Congress. Quite a large percentage of the \$130,000 appropriated is now spent in finding, purchasing, importing, and distributing rare seeds and plants.

The Department is in receipt of letters from seedsmen throughout the country urging the discontinuance of this work, and there is an uneducated sentiment here and there cooperating with the seedsmen along this line, which prompts ill-informed individuals to concur with these representations. I am well satisfied that the introduction and distribution during the last two years of seeds and plants rare or not found at all in the United States has been worth more money to the people of the country than all the expenditures of Congress for seed distribution to date. To the extent to which the distribution by the Department competes with the sales of seedsmen and others distributing precisely the same kinds of seed, with no experimental feature and no intelligent direction regarding the use of the seeds beyond that which is provided by dealers, the practice is questionable. But the furnishing to the people of the United States of sugar-beet seed of the most approved quality, for experimentation, to ascertain where beets can be grown sweet enough to produce our own sugar, is justifiable; the introduction of drought and rust-resisting grains from foreign countries, which are urgently needed by people in the United States who are losing heavily from drought and rust, is justifiable; the rehabilitation of the Western ranges that have been destroyed and in many cases reduced to desert conditions by injudicious grazing, is justifiable; the encouragement of tea growing in the States along the Gulf of Mexico, where labor is as plenty and as idle as anywhere in the world, is justifiable; the inquiry into the several plants that produce rubber, the gathering of the seed of these plants, their germination and preparation for setting out in such localities in the new island possessions of the United States Government as may be best suited for producing the \$30,000,000 worth of rubber now purchased from foreign countries, is justifiable; the introduction of the date palm from Tripoli in Arizona, establishing a new industry in that region which may extend to other localities in the same latitude, is justifiable. The introduction of these and many other seeds and plants, entirely beyond the ability of private individuals to compass, in order that such seeds and plants may eventually enter the commercial class and be handled by seedsmen, is the aim of the Department of Agriculture in seed distribution at the present time.

SUGAR BEETS.

During the last three years extensive experimentation has been had in cooperation with most of the States of the Union to ascertain where sugar beets can be produced sufficiently sweet to justify extensive growing and manufacturing. It has been fairly well demonstrated that many States have soil and climate, fuel, water, and limestone admirably adapted for this industry. Thirty-two factories are now in operation and many more in contemplation. There is every indication that the United States will produce its own sugar within a few years. The rich valleys of the mountain and Pacific coast States find sugar making very profitable. It is being demonstrated that the rich cornfields of the Northern States are also admirably adapted to the growth of the sugar beet. This industry will eventually be more profitable where the by-product is fed to the dairy cow and other domestic animals. The Department publishes annually a report setting forth all the facts in relation to this industry and the latest developments of interest to producers.

THE MARKET FOR AMERICAN HORSES.

Within the last two years horses have greatly appreciated in value and exports have rapidly increased. The Department issues annually a revised report, giving horse raisers facts regarding exports, as well as the requirements and demands of foreign countries for horses for different purposes.

DOMESTIC TEA PRODUCTION.

EXPERIMENTS AT SUMMERVILLE, S. C.

An interesting experiment is being conducted at Summerville, S. C., in the production of tea. Three thousand six hundred pounds of dry tea were produced during the past season. Dr. Shepard, a gentleman of education and enterprise, who owns the garden, has overcome the difficulties arising along labor lines by building a school-house for the education of the children of his colored neighbors, where they are taught free of expense, with the understanding that they shall pick his tea when required, at a reasonable rate of wages. This class of labor in the South is very plenty and very idle. The elementary education and habits of industry acquired must have a good effect from every standpoint from which the best interests of these people can be considered. If a new industry of this kind can be introduced into the Gulf States, which will save the people of the United States the many millions of dollars now sent abroad for the purchase of this commodity, and at the same time provide light work for the young people who are now entirely idle, there is a double incentive to make research to the utmost regarding the production of a commodity in such universal use.

INVESTIGATIONS TO BE CONDUCTED.

Congress at its last session appropriated \$1,000 to enable the Department to conduct experimentation in tea growing. While the average rainfall at Summerville ranges between 50 and 60 inches, there are times when the rain does not fall for considerable periods. Experimentation is now being arranged for to ascertain whether by irrigation a more continuous growth can be maintained and more frequent picking of the leaves be had. Arrangements are also being made to experiment in the manufacture of green tea without the use of chemicals. The Department of Agriculture has a sufficient number of plants growing in pots to start experimental tea gardens in all the Gulf States from Florida to Texas, and including California. Efforts are being made to induce the experiment stations in those States to cooperate with the Department in conducting these experiments.

Experiments in South Carolina have shown that the production of 200 pounds of dry tea per acre is readily obtainable under favorable conditions, with a probability of double or perhaps treble that amount when the plants have arrived at full bearing. It is desirable to ascertain the limit of productiveness under all the varying conditions of surface, soil, and seed varieties. It is gratifying to note that the yield per acre has steadily advanced, in spite of all hindrances, from 50 to 150 pounds per annum per acre for the whole of the older tea gardens at Summerville within the past few years. The best varieties from all the countries of the Orient are being experimented with, and efforts will be made to add promising new varieties, both by importation and by hybridization. Experimentation of this nature is beyond the capacity of men of moderate means, and I am of opinion that it is entirely justifiable that Congress, through the Department of Agriculture, should assist in demonstrating the probability of raising tea in the United States, for home consumption at least.

It will be necessary as the work progresses to employ professional tea tasters of wide experience to indicate the value of the several varieties being experimented with. A higher valuation per pound may offset a lesser production. Experimentation in shading from the direct rays of the sun is very encouraging. The leaf thus produced was tender, very lustrous, and made a very delicate tea. The means of manufacturing must of necessity be increased, and the testing of new machinery as regards cheapness of work and thoroughness of execution provided for. It is desirable to study carefully the composition of tea made from the same bushes at different times during the picking season, to analyze the product in this country of gardens raised on soil from widely separated sources, and to test the effect on tea of different sorts of manure. This is a large and expensive kind of experimentation, requiring special chemical apparatus and unusual nicety and skill.

LEASING THE PUBLIC LANDS.**CONDITION OF THE RANGES.**

I have looked carefully into the condition of the ranges in most of the States west of the Missouri River. The Department of Agriculture has been conducting experiments in most of these States with native and imported grasses through the experiment stations, private individuals, and sometimes directly under the management of its own officers. Injudicious grazing has greatly impaired the capacity of the ranges to produce meats. Careful inquiry shows that in many cases the ranges do not support more than half the meat-bearing animals they did ten years ago. The ranges have been overstocked, the grasses have been eaten bare and pulled out by the roots, and where formerly nutritious grass supported a large number of animals, there is now left nothing but a desert of drifting sand.

The principal reason for this condition of the ranges undoubtedly is that no single individual has an interest in any one part of the public domain. The object of the flock master is to secure all the grass possible, irrespective of the effect it may have on the future condition of the pasture. Thousands of sheep that can not find grazing on the plains are being taken into the innermost recesses of the mountain systems.

LEASING AS A MEANS OF IMPROVEMENT.

It would seem wise to inaugurate a more sensible policy regarding these public grazing lands. They should be rented to individuals in sufficiently large areas and for a sufficiently long time to induce the lessee to give attention to their improvement. The title should remain in the United States, so that the homesteader might have an opportunity, under such conditions as would not interfere with the renting, to make settlement wherever practicable. The rents arising from these leases might very well be given to the States for such uses as they might deem wise, either for educational purposes or for irrigation work. A very considerable amount of money would come every year from these leases, with which the States could begin experimentation in the way of building dams and holding the water against a time of need. My main object in making this recommendation is that the lessee and the Department of Agriculture may enter into cooperative experimentation looking to the improvement of the grazing lands.

EFFORTS TO SECURE PLANTS FOR SEMIARID REGIONS.

There are millions of acres that can not be cultivated in any crops with which we are now familiar. The Department of Agriculture is searching the dry areas of the world for plants that may be successful in furnishing the materials of food to a greater extent than is now

practicable on our semiarid regions. The introduction of sorghum, Kafir corn, dry-land alfalfa, the Russian brome grasses, etc., is enabling the farmers of the States west of the Missouri to extend cultivation over lands that did not succeed in corn, or oats, or clover.

ABANDONED FARMS.

My attention has been called to what is known as the abandoned farms of New England. A personal inspection of some of these farms shows that they are not abandoned on account of sterility of soil, but are in many cases capable of affording a good living to industrious farmers, and under more favorable auspices than are farms in some of our newer States, on account of nearness to market, educational institutions, and other desirable environments. The Agrostologist of the Department has visited several of these farms to ascertain in what way help can be given by the introduction of grasses suitable to their various conditions, and the Soil Physicist will study conditions on these farms and indicate which soils may be profitably cultivated and which should be devoted to forestry. The Forester will also visit these localities and determine what varieties of trees are most desirable. The Department will endeavor to have Farmers' Bulletins prepared along these several lines for distribution among the farmers of New England.

TROPICAL IMPORTS.

Our imports of tropical-plant products have a value of about \$200,000,000 a year. Nearly all of these could be produced in Porto Rico, Hawaii, and the Philippines if the best use were made of the agricultural possibilities of these islands, and of American industry, ingenuity, and financial resources. Our tropical-plant imports are four times as great as the total exports of Hawaii, Porto Rico, and the Philippines. For coffee and sugar we pay an amount exceeding by more than \$80,000,000 the agricultural and all other exports of these islands. Omitting sugar and tobacco, our tropical-plant imports still greatly exceed the total agricultural exports of these tropical dependencies. Our imports of oranges, lemons, and cocoanuts have about the same value as the sugar and tobacco exports of Porto Rico, and could readily be produced on that island.

There are several staple agricultural imports of the United States other than oranges, lemons, and cocoanuts to which attention should especially be called as worthy of consideration for introduction into Porto Rico, such as vanilla, our imports of which vary in value from \$279,755 to \$1,013,608 per year; gutta-percha and india rubber, about \$30,000,000, and cacao, \$5,000,000. The improvement and extension of coffee culture in Porto Rico is well worth careful investigation and encouragement, since our total coffee imports in 1898 amounted to

\$65,067,631. There is every reason to believe that a portion of our banana imports, which during the year 1899 reached a value of \$5,665,588, may to good advantage be grown in Porto Rico.

INDIA RUBBER.

IMPORTANCE OF THE TRADE.

The india-rubber trade is of great importance to the United States and has shown a rapid increase during the last few years. For the fiscal year ended June 30, 1890, the total importations of crude rubber amounted to 33,842,374 pounds, valued at \$14,854,512, while that of manufactured rubber was valued at \$367,647. In the fiscal year 1898 the imports of crude rubber and gutta-percha amounted to 46,055,497 pounds, valued at \$25,386,010, while that of manufactured articles and waste or scrap rubber was 9,488,327 pounds, worth \$805,951. This shows not only a decided increase in the quantity imported, but also a rapid rise in price. In 1890 about two-thirds of the entire amount imported came from Brazil. In 1898 about three-fifths came from that country.

A recent United States consular report shows that the importations into England for 1898 amounted to 20,026 tons, about half of this being Brazilian. New fine Para rubber was quoted at New York from 66 to 69 cents per pound in 1893, 69 to 71 cents per pound in 1894, 73 to 77 cents in 1895, 74 to 88 cents in 1896, 80 to 87 cents in 1897, and 82 to 83 cents January 1, 1898. A single cargo of rubber, consisting of 1,167 tons, shipped from Para February 23, 1898, was valued at \$2,210,000 in United States gold. The exports of rubber from Brazil in 1898 amounted to \$38,400,000 gold.

COLLECTION AND TREATMENT AND SOURCES OF SUPPLY.

Rubber is derived from the milky sap of a number of trees and shrubs, all native to the tropical regions of South America and the Old World. There are many plants with milky sap which contain small quantities of rubber, but none are known which produce it in commercial quantities anywhere outside of the Tropics. The methods of collection and treatment of rubber are, in the main, very crude. There is a great deal of waste and considerable deterioration through improper methods of treatment in the field and in transit, and through impurities. The only successful experiments at cultivating rubber plants which have thus far been made were undertaken by the English Government in Ceylon, India, and some of the other tropical colonies. By following the most improved methods of cultivation and by giving the rubber plantations the same careful attention which is devoted to other crops, it appears possible to make this an exceedingly profitable investment.

The larger part of the Brazilian rubber is produced by the Para rubber tree, *Hevea brasiliensis*, which grows naturally in the deep shade of the swampy forests of the Amazon, where the air is fever-laden and the land is unsuited for human habitation. Experiments have been made with this tree in various of the British possessions in the East Indies, but without any marked degree of success, because the tree attains its full development only in the shade of dense tropical jungle lands and not in the solid plantations. Its successful handling appears to lie in the direction of a proper system of forest management. The Central American rubber tree, *Castilloa elastica*, grows only in the dense tropical forests from southern Mexico to northern South America, on rich, well-drained bottom lands along the rivers. This tree has been found to grow luxuriantly under cultivation, but in the experiments thus far tried it develops a bark much thicker than in its native state, and this has been found a decided drawback to the successful drawing of the sap.

The Ceara rubber tree, *Manihot glaziovii*, is a native of one of the driest portions of southern Brazil, where the mean temperature ranges from 77° to 86° F. There are now many plantations of it in India and Ceylon, and it is probable that this tree will be the first to produce an important addition to the natural supply of india rubber. There are fifty or more species of trees, vines, and shrubs which are a commercial source of india rubber and gutta-percha, and the list is annually increasing. Experiments should be tried in the cultivation of every one of them. Gutta-percha is derived almost entirely from the tree *Isonandra gutta*, a native of the islands of the Malayan Archipelago. The careless methods of the collectors have resulted in killing off most of the plants from which this substance is derived, so that a serious shortage has occurred during the last few years. The feasibility of cultivating this plant in the Philippines should be very carefully investigated.

TURKESTAN ALFALFA.

The unusually severe winter of 1898-99 killed off probably half of the alfalfa of western Kansas, Nebraska, Colorado, and Wyoming, and many fields in the central prairie States to the eastward were badly damaged, but the Turkestan alfalfa grown in the States mentioned was not affected. At the Wyoming experiment station a plat of Turkestan alfalfa was exposed for two weeks without injury to a daily temperature of —35° F., the lowest point reached being —45°. In California it was subjected without damage to a drought which seriously injured ordinary alfalfa. In view of the notable success of this plant in withstanding drought and cold, it has been decided to purchase a large amount of seed grown in America from our imported stock and to distribute it widely over the arid West until it has been thoroughly tested under all the different climatic and soil

conditions existing in that region. From the results already secured, it is believed that this one introduction will add millions of dollars to the annual hay product of the United States.

INTRODUCTION OF IMPROVED RICE.

About fifteen years ago the enterprising farmers of southwestern Louisiana began to adapt modern machinery to use in their rice fields, and within a decade they had replaced the antique implements of the hand laborer by the gang plow, disk harrow, drill, and broadcast seeder; they had insured sufficient water by the construction of irrigation canals; and, finally, they had adapted the twine binder of Northern wheat fields to the cutting of rice. So far as methods were concerned, they had created a new system of rice culture which greatly reduced the cost of rice production. It was discovered, however, that sufficient attention had not been paid to the question of varieties. The Louisiana rice, when milled, gave a high percentage of broken grains, and much of it brought, therefore, only a second-class price.

To remedy this difficulty the Department of Agriculture undertook to secure a productive rice of high milling quality. This it has succeeded in doing by importing, after a careful search in Japan, a quantity of Kiushiu rice. In yield this rice has proved a distinct success, and if, as is expected, it maintains in Louisiana the high milling average that it possessed in Japan, hundreds of thousands of dollars will be added to the yearly profits of Louisiana rice growers.

In this connection, it may be said that flattering reports have been received about many of the other introductions of the Department, and from time to time, when these reports are amply substantiated, due commendation of these crops will be made to the agricultural public.

NATIVE DRUGS.

The collection of native drug plants in the United States, considered from a purely financial standpoint, aside from medical and humanitarian aspects, involves the expenditure of millions of dollars annually. The commercial extermination of some of the most useful species is already threatened, and doubtless others would be found in the same condition were the facts known. The price of one native plant, ginseng, our exports of which average more than half a million dollars annually, has more than quadrupled in the past thirty years, so that its cultivation, as urged four years ago by this Department, has now become profitable. It is clear from this and many similar cases that the native drug industry is capable of either decline or improvement, according to the way in which we handle it.

The Pan-American Medical Congress has recently submitted to me a proposition to cooperate with this Department in a technical and statistical investigation and classification of our native drug plants.

By accepting this proposal we shall secure, in a research of which we have long felt the need, the cordial assistance and support of an influential association of learned physicians; we shall encourage each of the other American nations, all of which are represented in the Pan-American Medical Congress, to proceed with a similar investigation of their own medical flora; we shall furnish a basis for the remunerative employment of much land and many people, and we shall stimulate the great and growing trade in drugs between the countries of North America and South America. I urge the appropriation of \$10,000 to enable this Department to cooperate in this investigation.

HEMP.

Our imports of hemp fiber for the past five years have averaged in value \$678,475 annually, coming chiefly from Italy and southern Russia. This hemp is worth about 7 cents per pound and is used principally in the manufacture of carpet warps. In addition, we import an unknown but doubtless large amount of manufactured hemp in the form of the cheaper grades of linen. The domestic product of hemp reported by the last census, at a valuation of 3 cents per pound, was worth \$690,660 and was grown chiefly in Kentucky. This hemp is used principally in place of jute butts for cordage purposes. The Kentucky hemp producers grow a short plant in small areas with shallow plowing and little or no fertilizing. The crop is reaped and broken by hand, and the fiber is extracted by the process of dew retting. In addition to these heavy charges, an annual rental, averaging probably \$10 per acre, is ordinarily paid for the land. There is a reasonable prospect of establishing an extensive hemp industry in the United States on new lines, involving the use of either a taller variety or two crops of the short variety, growing the crop on large areas of cheap land, plowing deep, putting on the necessary fertilizers, reaping and breaking by machinery, and using the process of water retting.

EGYPTIAN COTTON.

The importation of cotton from Egypt steadily increased from less than 200,000 pounds in 1884 to more than 43,000,000 pounds in 1896. Since the latter date, the direct importations from Egypt have fallen off slightly, but the prices have had an upward tendency, and the demand for this staple remains good at from 4 to 6 cents higher than the price of ordinary American upland cotton. Our annual import of cotton from Egypt for the past three years has averaged in value \$3,738,338. The Egyptian cotton has a very fine silky fiber, generally shorter than that of sea island but longer than that of upland varieties. It is used in the manufacture of fine yarns for the finer qualities of hosiery and knit goods. It does not come into direct competition with our upland cotton, the fiber of which is too coarse for the finer yarns. Some attempts have been made to grow Egyptian cotton

in this country, and in 1894 the Department imported and distributed a stock of Egyptian seeds. The experiments with these have shown promising results, but there is need of further trial to determine the exact conditions under which this cotton can be grown to best advantage. There is good ground for hope that with proper management the industry may become well established in the United States.

NEW LABORATORY BUILDINGS.

The Department of Agriculture is now conducting all of its laboratory work in rented buildings located outside of the Department grounds. These buildings are for the most part mere makeshifts, consisting of dwelling houses remodeled to permit laboratory work. Some of them are overcrowded and none are fireproof. There are five of these buildings which, with rent and other expenses, cost the Department about \$10,000 a year. The work carried on by the laboratories is of the highest importance, including the investigations of the Bureau of Animal Industry, the Division of Chemistry, the Division of Vegetable Physiology and Pathology, the Division of Soils, and the Division of Botany. Much of the material now in use by these branches of the Department, as well as that being constantly accumulated by them, is of great value, and it would be impossible to replace it in case of loss by fire. It is absolutely necessary that better facilities be secured for this scientific work, either by the rent of additional buildings or by the erection of a Government building.

As best adapted to our necessities, plans have been prepared for suitable buildings to be erected upon the Department grounds. The plans show structures which are fireproof throughout, and which are arranged so that the several lines of work can be kept as distinct as may be required by their nature, and at the same time the buildings be heated, lighted, and ventilated from one central plant. The several laboratories are now occupying, approximately, 35,000 square feet of floor space, and the new buildings provide about 10 per cent increase over this to allow for future growth. Careful estimates show that the buildings as planned will cost, approximately, \$200,000. I therefore earnestly recommend that this amount be appropriated, as it will not only be a saving of money to the Government, but will at the same time furnish facilities commensurate with the importance of the work.

A PROPOSED ARBORETUM.

One of the needs of the Department is an arboretum in which can be brought together for study all the trees that will grow in the climate of Washington, D.C. The need of such an establishment was felt early in the history of the Capital, and was brought forward more than fifty years ago among the various plans proposed for the use of the Smithsonian bequest, which was finally devoted to the founding of the

present Smithsonian Institution. In the report of the building committee of that institution for 1850 the following statement occurs:

Mr. Downing, the well-known writer on rural architecture, at the request of the President, is now preparing a plan for converting the whole Mall, including the Smithsonian grounds, into an extended landscape garden, to be traversed in different directions by graveled walks and carriage drives and planted with specimens, properly labeled, of all the varieties of trees and shrubs which will flourish in this climate.

This admirable plan, apparently from lack of financial support from Congress, was never systematically prosecuted, and the plantings at first made were so neglected that the nurse trees crowded out and killed most of the valuable sorts, and even the nurse trees themselves are now being rapidly broken down and destroyed by storms, disease, and decay. When the grounds of the Department of Agriculture were laid out in 1868, Mr. William Saunders, then, as now, Horticulturist of the Department, established a small arboretum commensurate with the size of the grounds. An arboretum in this climate, however, requires an area of several hundred acres. The time has come when the economic needs of the Department and the education and pleasure of the people demand a rich collection of trees planted so as to secure the best effects of landscape art, furnishing complete material for the investigations of the Department of Agriculture, and so managed as to be a perennial means of botanical education. We are now engaged in introducing useful trees from all parts of the world, such as those producing fruits, dyes, nuts, oils, and tans, those useful for ornamental purposes, and especially those promising shade, shelter, and fuel in the arid region. At the present time we have no central place in which to plant and maintain a series of these trees for study and propagation. The importations must be sent out as fast as they are received, without an opportunity for our investigators to make any observations on their behavior under cultivation, and, in the case of small and valuable importations, subjecting the whole stock to the possibility of total loss. In view of these conditions, I wish to bring to the attention of Congress the importance of placing at the disposal of this Department an area of suitable size and situation for a comprehensive arboretum. In order to give a specific basis for consideration of this project, I suggest that the area known as the Mall be set aside for this purpose.

AGRICULTURAL EDUCATION.

NECESSITY OF AGRICULTURAL TEACHING IN INSTITUTIONS OF LEARNING.

The great prosperity of the country at the present time has resulted, among other things, in a largely increased attendance upon our universities, colleges, and other institutions of learning. When we consider that half the people of the United States are occupied in pro-

ducing from the soil directly; that about three-fourths of our exports to foreign countries come from the soil, and that the \$600,000,000 balance of trade coming to the United States during each of the last two fiscal years have been, to a great extent, the price of farm products, it is somewhat remarkable that so very little attention is given to the education of half the people of the nation and their preparation for their future life work.

The beautiful valleys of the mountain and Pacific-coast States are being injured to a considerable extent by the injudicious use of irrigating waters. The pasture lands of the public domain west of the Missouri River are being rapidly destroyed by injudicious grazing. The wheat-growing area of the country, where crops are grown continuously, are refusing to yield as they did when first brought under cultivation; and from the Dakotas to the Pacific we find systems of fallowing in operation and crops of wheat being taken once in two years, indicating the rapid destruction of the plant food in the soil.

SCIENTIFIC TRAINING IN THE DEPARTMENT.

The people cry aloud to this Department for help. We have gone repeatedly but in vain to the Civil Service Commission and had them advertise throughout the country for soil physicists in order that we might cooperate with the people regarding the deterioration of their soils. All the older sections of the United States have injured their soils by injudicious management. A knowledge of plants—their life history, the diseases to which they are subject, their relations to the soil, the climate, and food necessary to their best development—is so scarce among us that plant physiologists and pathologists can not be found by advertising for them.

Animal husbandry is very little understood, and in most of the educational institutions of the country sufficient instruction is not being given to have it better understood, yet from this source we make our most profitable sales to foreign countries. The Biological Survey and other Divisions have also to train the men to do their work. When the Department requires the assistance of men educated along these lines it is necessary to educate them in its own scientific Divisions, under the direction of its own scientists. When it has trained such men until they become expert and stand at the head of their specialties in the United States (and in many cases in the world), then wealthy institutions take them away by offering higher salaries, interfering with the work of the Department, along the lines mentioned, which is so necessary to the producers of the United States.

REGISTER OF GRADUATES OF LAND-GRANT COLLEGES.

To meet some of these difficulties and avoid in future their frequent recurrence, I have arranged with the Civil Service Commission to make a register of the graduates of the land-grant colleges of the

United States (those endowed by Congress to educate the young farmers of the country). From this registration the scientific Divisions of the Department select young men who will assist the Division scientists in their work, and have opportunities for post-graduate study and for better preparing themselves along the lines of applied science, whereby the producer is helped by the scholar. We pay these young men no more than we pay a laborer, and much of the work they will perform in the Divisions could be performed by skilled laborers.

Slight inquiry into education along the lines of agricultural science will show that there is no university in the land where the graduate of an agricultural college who has been studying along the lines indicated can take post-graduate work. The scientific Divisions of the Department of Agriculture come nearer furnishing the necessary facilities than can be found elsewhere. If two or three young men come to each of our scientific Divisions and study along the lines of the application of science to production in the field, the stable, and the farm factory, the Department will in a few years have a force from which it can not only fill vacancies when wealthy institutions take away trained men, but be able to supply the agricultural colleges, experiment stations, and other scientific institutions in the land with men of superior scientific attainments in these branches.

EFFORTS OF THE DEPARTMENT TO MEET THE DEMANDS FOR HELP.

By this new departure the Department is merely arranging to meet the imperative demands of the producers of the country for help to solve the problems that are beyond their education and their means. The Congress of the United States, in providing for the endowment of agricultural colleges and experiment stations, did more for the agriculture of the country than has been done by governmental agency for the people of any other nation. Congress could not endow these institutions with teachers trained in the applied sciences relating to the farm, but Congress has built up the Department of Agriculture and encouraged the development of the foremost scientists known in their several specialties. The step we have taken toward bringing the brightest students of the agricultural colleges to prosecute their studies under the supervision of scientists in this Department is one step necessary to complete the educational system.

Something no doubt remains to be done at the other end of the educational line. The education of the young farmer in the district and high schools should be such as to help him toward the agricultural college. The other educational institutions of the country have done their work well, but so abundantly that the college graduate upon leaving college is not sure of employment that will give the salary of a brakeman on the railroad. Only a very few of those who upon leaving college must earn their livelihood through their literary

education are sure of incomes equal to that of a locomotive engineer. The great unexplored field for the educator is along agricultural lines. Half the people of the United States are interested in it. The prosperity of our country as a nation among nations depends upon it.

I hope to have the approval of Congress in this effort to provide for the higher education of the graduates of the agricultural colleges by appropriations sufficiently considerate to justify the very moderate expense that will be entailed.

AGRICULTURAL TEACHING IN THE COMMON SCHOOLS.

In my last Annual Report, I referred to the growing interest in elementary instruction in the sciences that relate to agriculture, and mentioned the special appropriation of \$25,000 made by the State of New York to be used in aiding the introduction of nature teaching into the common schools and the carrying on of simple agricultural experiments in different parts of the State under the supervision of the college of agriculture of Cornell University. Encouraging progress has been made during the year in this movement. The work at Cornell has been materially extended, and colleges in other States are affording opportunities for teachers in the common schools to receive such special instruction as will fit them to give elementary courses in nature study. In Missouri a recently enacted law calls for instruction in agriculture and horticulture in the common schools, and during the past summer a considerable number of Missouri school superintendents and teachers spent some time in attending lectures and formulating elementary courses of instruction in these studies.

CONCLUSION.

The Department, through its Bureaus, Divisions, and Offices, is getting into more immediate contact with all classes of producers throughout the country. More extensive cooperation is being entered into between the Department and the experiment stations of the several States. Especial attention is being given to the reclamation of soils that have been reduced in fertility by injudicious management. Production from the soil in all parts of the United States is being diversified by importations from foreign countries. The scientist and the cultivator are working together for greater national prosperity through more economic production. The farmers of the country are having their knowledge increased through the publications of the Department and the experiment stations, and the future tillers of the soil are being better educated in the agricultural colleges as teachers are developed who more thoroughly understand the application of science to practical agriculture. The field of operations for the future activity of the farmer is from the Arctic Circle to the Equator. New problems, requiring scientific investigation and entirely

beyond the ability of localities or private individuals to solve, are presented from both extremes. The especial attention of the Department in the future will be given to the production, under United States jurisdiction, of products of the soil that now come from foreign countries, keeping steadily in view the object for which the Department was organized—the help of the producer who is struggling with nature.

Respectfully submitted.

JAMES WILSON,
Secretary.

WASHINGTON, D. C., *November 21, 1899.*

DEPARTMENTAL REPORTS.

REPORT OF THE ASSISTANT SECRETARY UPON THE PURCHASE AND DISTRIBUTION OF SEEDS.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE ASSISTANT SECRETARY,
Washington, D. C., October 10, 1899.

SIR: I have the honor to submit herewith the report regarding the distribution of seeds for the year ending June 30, 1899. A recapitulation shows that of the \$130,000 appropriated by Congress for the "purchase and distribution of valuable seeds," etc., there was expended, under contract—

For the purchase of seeds for distribution through Members of Congress	\$70,978.36
For rare and valuable foreign seeds distributed by the Section of Seed and Plant Introduction of the Division of Botany	18,320.92
For sugar-beet seed purchased and distributed by Dr. Wiley	2,366.00
For seeds and bulbs purchased by Mr. William Saunders and distributed by Members of Congress	3,400.00
For foreign seeds, etc., distributed through the Division of Botany	1,980.00
For special purchases of seeds distributed by Captain Whittleton under the immediate supervision of the Assistant Secretary	3,000.00
Total	99,823.43
For salaries of employees connected with the seed distribution	25,912.98
For miscellaneous supplies in connection with the seed distribution	221.85
Grand total	125,958.26
Balance on hand June 30, 1899	4,041.74

There are yet outstanding a few vouchers which will reduce the amount unexpended to some extent.

According to the contract made with the New York Market Gardeners' Association, to whom the contract was awarded, the seeds purchased for general distribution through Members of Congress were put up and sent out from the city of Washington instead of from the city in which the business of the contractor was located, as was the case last year. This was found to be a much better arrangement, and resulted in a more satisfactory distribution of the seeds.

CONGRESSIONAL DISTRIBUTION.

The Congressional distribution of seeds has been so fully covered in the special report of the chief of the Seed Division, Capt. R. J. Whittleton, that I append it here in full, as follows:

U. S. DEPARTMENT OF AGRICULTURE,
SEED DIVISION,
Washington, D. C., August 28, 1899.

SIR: In compliance with circular letter dated June 27, 1899, I have the honor to submit the report of the seed distribution and the work of the Seed Division in connection therewith for the fiscal year ending June 30, 1899.

The records of this Division show the aggregate of all seeds distributed by the contractor (the New York Market Gardeners' Association) to have been 14,238,168 packets, which were allotted and distributed as follows:

To Senators, Members, and Delegates in Congress, 12,999,159 packets of vegetable, flower, and field seeds.

To correspondents of the Division of Statistics, 727,585 packets of vegetable, flower, and field seeds.

To the United States Weather Bureau, 69,685 packets of vegetable seeds.

To masters of granges, 205,000 packets of vegetable and flower seeds.

To miscellaneous, 238,739 packets of vegetable, flower, and field seeds.

The cost to the Department of the 14,238,168 packets of seeds distributed was \$70,978.36, as per contract awarded.

In addition to the above contract list, there was expended for various kinds of seeds, which were distributed miscellaneously by the Seed Division during the fiscal year, the sum of \$4,358.36. These seeds were sent to such localities as were best adapted for their culture, and at proper time for planting. Among the varieties distributed were wheat, oats, buckwheat, field corn, velvet beans, cotton, grasses, turnip, and vegetable seeds, of which a record has been kept in this Division showing where, when, and to whom the same have been sent.

Referring again to that part of the distribution which had been contracted for with the New York Market Gardeners' Association, I have to say that the work was begun about January 1, 1899, or soon thereafter, and ended on or about May 9.

Mr. A. C. Nellis, acting in the capacity of manager for the contracting association, being himself a member of the firm, had charge of the distribution in so far as the said firm was obligated by contract. Mr. Nellis was much of the time greatly handicapped in the work of distribution by delays of large shipments of seeds while in transit to this city, causing waste of much valuable time. In some cases the varieties named in the contract list were not procurable and substitutes had to be made, which not only caused still more delay but added new perplexities to the situation.

Notwithstanding these annoyances and hindrances, Mr. Nellis kept steadily at his work, doing everything in his power to meet the requirements of the Department as set forth in the contract. I deem it due to this gentleman to express here my appreciation of his indefatigable efforts and honorable dealing with the Department in all that pertained to the seed distribution. In fact, to Mr. Nellis's ability, coupled with the good judgment and business qualifications of Mr. James Morison, who represented this Division in the capacity of special agent, is

mainly due whatever was creditable to the Department in the last seed distribution. Such delay as occurred must in no case be charged either to this Division or to the contractor.

Some delay was occasioned by the work of testing the percentage of germination in the seed laboratory. From this cause not only was the contractor prevented from going forward in his work, but in some cases the delay in testing the seed made it impossible to get parts of the Congressional quotas to their destinations in time for planting. It would seem, therefore, most desirable that arrangements should be made precluding the possibility of such delay in future.

The enormous amount of seed which makes up the Congressional distribution list can not be considered other than a commercial list. To formulate this and send out the seeds in ample time for planting is but a plain business proposition, and is enjoined by the highest law-making power in the land.

The law with reference to the Congressional seed distribution makes it mandatory on the Secretary of Agriculture to have these seeds ready for distribution by the tenth of January, or soon thereafter, and this date is none too early for many of the Southern States.

Two things are both essential and important in this distribution, namely: First, to procure as many good standard seeds as possible for the amount of money expended; second, to send them out in ample time for planting.

As regards the quality of the seeds sent out in the last distribution, I am pleased to be able to state that many reports have already come to the Seed Division, of which nearly all are highly favorable.

Respectfully,

R. J. WHITTLETON,
Chief of the Seed Division.

Hon. J. H. BRIGHAM,
Assistant Secretary.

INTRODUCTION AND DISTRIBUTION OF FOREIGN SEEDS.

The following notes on the introduction and distribution of rare and valuable foreign seeds and plants by the Section of Seed and Plant Introduction of the Division of Botany are furnished by the special agent in charge of that section, Mr. O. F. Cook:

The distribution and testing of seeds secured in Russia and Central Asia by Prof. N. E. Hansen, as explained in last year's report, have been continued, and the value of some of these introductions has already become apparent. Twelve tons of seed of a hardy strain of *Bromus inermis* enabled experiments to be made in numerous localities in the Northwest, and reports therefrom indicate that this species is likely to become the most valuable and widely cultivated grass in the subarid region. Requests for seed continue to be received in large numbers, and it has been necessary to import additional quantities from Europe.

The alfalfa seed procured by Professor Hansen in Turkestan has also given satisfactory results, being distinctly more resistant to cold as well as to drought than the variety previously known in the United States. This will make possible a considerable extension of the cultivation of this valuable crop.

The winter muskmelons from Turkestan have proved not to be suited to the cooler and more humid East, but are well adapted for cultivation under irrigation in the arid Southwest, and an additional amount of seed of one variety is being grown for the Department in Utah in order to permit a more extensive distribution. A fine specimen of this stock was received from Utah late in January, 1898. Such a melon would undoubtedly prove a popular novelty in the fruit market.

During the fiscal year 1898-99 four agricultural explorers have visited foreign countries for the Section of Seed and Plant Introduction. Hardy cereals and forage plants were secured in European Russia by Mr. M. A. Carleton. Japan was visited by Dr. S. A. Knapp, of Louisiana, for the purpose of obtaining a variety of rice which should be superior in milling qualities to those now grown in the South. Ten tons of seed of the finest Japanese variety from the Island of Kiushiu were imported and distributed in the Southern States, particularly Louisiana.

Mr. Walter T. Swingle investigated numerous agricultural industries in Germany, France, Italy, North Africa, Greece, and Turkey. Many leguminous and other forage plants, including the carob tree, a spineless cactus, and a new vetch, also cereals from North Africa and Hungary, were obtained, besides a series of superior French vegetables, including many not now grown in this country, and numerous varieties of the European grape, grafted on resistant American stocks. Mr. Swingle also sent home a series of varieties of capriffs, as well as the fig insect (*Blastophaga*) which, under the care of the Division of Entomology, is rapidly multiplying in California, thus rendering probable the establishment of an extensive Smyrna fig industry.

Arrangements have been made for introducing superior varieties of date palms from Algeria. These are to be propagated at the Arizona experiment station. Later they may be distributed throughout the arid, alkaline regions of Southern Arizona and California, where this useful tree has been found to thrive.

Mr. David G. Fairchild, formerly in charge of the Section of Plant Introduction, was detailed in November last to accompany Hon. Barbour Lathrop, of Chicago, on an expedition to South America, where he found much of interest and probable importance, particularly for the South and Southwest.

In all, over two thousand different species and varieties of economic plants have been received during the year. In most cases, however, the quantities secured were sufficient only for tests to be made by the various State experiment stations and by a few private specialists. The results are, of course, not yet known, but some very favorable reports have already been received. To assist in the distribution of this extensive series of miscellaneous seeds and plants, an issue of printed lists or inventories has been found necessary. These lists enable the Department to place in the hands of experimenters the special information obtained by the agricultural explorers regarding the origin, nature, value, and methods of cultivation of the new crops.

DISTRIBUTION OF SUGAR-BEET SEED.

The following statement of the purchase and distribution of sugar-beet seed during the past season is furnished by the Chemist of the

Department, Dr. H. W. Wiley, by whom this seed was purchased, mainly from the fund for the investigation of the domestic sugar production. The distribution was directed by the Chemist, but was actually carried out through the Section of Seed and Plant Introduction of the Division of Botany.

The amounts and cost of sugar-beet seed purchased and distributed in 1898 are as follows:

Five metric tons "Zehringen" beet seed from Adolph Strandes, Zehringen, Germany, at \$160.....	\$800.00
Freight from New York to Washington, D. C.....	34.65
Consular invoice.....	2.50
Three metric tons Knauer's "Mangold Elite" beet seed, through H. Cordes, Lagrande, Oreg.....	501.00
Freight from New York.....	31.20
Five metric tons Dippe's "Kleinwanzlebener Elite" beet seed, through August Rölker & Sons, 52 Dey street, New York, agents, at \$195.....	975.00
(Freight prepaid.).....	
Five metric tons "White Improved Vilmorin" beet seed, through Willett & Gray, 91 Wall street, New York, agents, at \$176.40.....	882.00
(Freight prepaid.).....	
Total.....	3,226.35

The weight of seed purchased and donated by varieties was as follows:

	Pounds.
White Improved Vilmorin.....	11,025
Knauer's Mangold Elite.....	6,615
Dippe's Kleinwanzlebener Elite.....	11,025
Strandes Zehringen.....	11,025
Total purchased.....	39,690
Biendorf Elite Kleinwanzlebener.....	2,420
Total weight of seed distributed.....	42,110

The Biendorf seed was grown by Carl Braune, Biendorf, Germany, and was presented to the Department by Hoff Brothers, Chicago.

Nearly one-half of this seed was distributed among twenty-nine of the State experiment stations and the remainder to individuals and associations, either at the request of Members of Congress or on direct application.

The beet-sugar industry is already so well established in California that but few applications for seed were received from that State. The largest quantities of seed were sent to the States of Colorado, Illinois, Indiana, Iowa, New York, North Carolina, North Dakota, Ohio, Pennsylvania, West Virginia, and Wisconsin. Apparently the best results from the experiments are obtained through the distribution of the seed by the stations and by the associations formed for the purpose. In general, the seed sent to individuals on direct application to the Department does not yield very satisfactory results. This is due to lack of competent supervision of the experiments.

Respectfully,

J. H. BRIGHAM,
Assistant Secretary.

Hon. JAMES WILSON, *Secretary.*

REPORT OF THE CHIEF OF THE WEATHER BUREAU.

U. S. DEPARTMENT OF AGRICULTURE,
WEATHER BUREAU,
Washington, D. C., August 28, 1899.

SIR: I have the honor to submit a report of the operations of the Weather Bureau during the fiscal year that ended June 30, 1899.

Respectfully,

WILLIS L. MOORE,
Chief of Bureau.

Hon. JAMES WILSON, *Secretary.*

WORK OF THE YEAR.

FORECASTS.

Timely and important warnings of severe storms, hurricanes, cold waves, and frost were issued on a number of occasions. The closing months of 1898 were especially stormy on the Gréat Lakes and the New England coast. Probably the most severe storm within the memory of the living swept along the Massachusetts coast on November 26-27, entailing a loss of at least 200 lives and many vessels. This appalling loss of life was largely due to the sailing of one vessel, the *Portland*, with a passenger list of probably 150 souls. The captain of the *Portland* left Boston Harbor at the regular time for sailing (6 p. m.), although storm signals had been flying since 11 a. m. and marine interests had been completely notified of the coming storm. The disasters of this storm will not soon be forgotten, yet what might have been the record of death and destruction if the harbors of the New England coast had not been filled with hundreds of craft which had sought a safe anchorage on the advices of the Weather Bureau.

The extension of the usual time limits of the night forecast from thirty-six to forty-eight hours marked an important change in the forecast work of the Bureau. Persons who receive the forecasts through the morning newspaper frequently wish to know the weather conditions to be expected on the coming day. Although attempts to extend the time covered by the forecasts had been made heretofore they were not successful. In the full belief that, as a result of the special study of the problem of forecasting made during the past two years, such an extension was not only practicable but very greatly desired, forecast officials were directed that beginning March 1, 1899, the period covered by the night forecasts should be increased to forty-eight hours. The success already attained has fully justified the issuance of the order.

SEVERE STORMS.

The only hurricane in the West Indies during the season of 1898 followed closely the establishment of stations in that region.

At 12.40 p. m. September 10, the United States Weather Bureau observer at Bridgetown, Barbados, cabled a special report which showed the presence of a cyclonic disturbance southeast of the Windward Islands. Hurricane warnings were immediately cabled to Weather Bureau stations in the Lesser Antilles, and the officials in charge were instructed to give the widest possible distribution of the warnings in their respective districts. In the meantime, and immediately following the dispatch of his special message, the Weather Bureau observer at Bridgetown warned all local interests of the approach of the hurricane. The storm reached the island of Barbados the night of September 10, and the islands of St. Vincent and St. Lucia the morning of September 11. At Barbados 83 persons were killed, 150 injured, and property to the estimated value of \$2,500,000 was destroyed. The following are among comments made by the press in connection with this storm and the warnings issued by the Weather Bureau in advance of its arrival:

[From the Barbados Advocate, September 17, 1898.]

Saturday morning was dark and lowering, and the indications of approaching bad weather were strong. At noon Mr. McDonough, of the United States Weather Bureau, notified the public that a hurricane was fast approaching Barbados. At 6 p. m. the clouds gathered densely in the northeast and the wind commenced to blow freshly from that point. The rain fell heavily, and the clouds continued to gather in dark, ever-wheeling columns, the higher banks forming scuds flying rapidly to various points. At 7 p. m. the barometer had fallen to 29.66, and the wind had increased in force and violence until a strong gale was blowing. At 9 p. m. the wind was blowing with hurricane force.

Fiercer and more destructive hurricanes may have visited the West Indies in years past, but taking into consideration the general condition of her industry and its gloomy prospects never has a more appalling calamity fallen on this island since it first rose out of these western seas than the fearful hurricane which ravaged it from shore to shore on Saturday night last.

[From an editorial in the New Orleans Times-Democrat, September 24, 1898.]

We were able to test this new service in the recent hurricane of September 10 and 11. The storm which prevailed then was first noticed in an inchoate condition near Barbados on September 10. All the other West Indian islands were notified from Washington, and it was in consequence of that notice that the Spanish vessels at San Juan de Porto Rico, which were to have sailed for Spain on that day, delayed doing so, escaping the storm and saving, in all probability, many lives by their delay. Every seaport that could be reached by telegraph was notified; the vessels remained in harbor, and the hurricane, a very severe one, swept through the Caribbean and the Gulf of Mexico without injuring a single vessel. So much for our new weather stations. There was some loss of life in the interior of the islands, where the warning could not reach in time, but this was infinitesimal compared with the damage that might have been done and would have been done had the approach of the storm not been known one or two days beforehand.

The hurricane was very severe over the smaller Antilles and wasted most of its force before it reached Cuba. All we caught of it was a violent rain storm. But although it was not as widespread as some other Gulf hurricanes, it was as severe in its intensity where it did rage. By the warning given by our weather service property in value a hundred times the cost of the service was saved. The wisdom of the new stations is thus clearly proved. Louisiana ought to appreciate the improvement, for probably no part of the country is more affected and more directly interested in hearing of the approach of these hurricanes. With timely notice vessels will not leave here in the face of a storm. The thousands of fishermen along the coast can receive warning in time and escape the fate of their comrades at Cheniere Caminada. Finally, the sugar and rice plantation owners are deeply interested in knowing of an approaching blow, so as to give them a chance to care for the crops, to harvest the rice or cut the cane before the storm breaks over them.

In enumerating the benefits of the war we must not overlook the improvement it has assured us in our weather service on the Gulf and South Atlantic, an

improvement that would scarcely have been made, certainly not made for years, if the safety of Sampson's and Watson's fleets and Shafter's army had not demanded the establishment of additional weather stations in the West Indies.

[From the Daily Gleaner, Kingston, Jamaica, September 16, 1898.]

Among the most notable features attending the hurricane was the action of the United States weather station at Half Way Tree. This station was only established a few weeks ago, under the scheme of the Washington Bureau for covering the meteorological observation of the West Indies more effectually than heretofore; and already the new station has more than justified its existence. From the data which, with more or less regularity, have been coming to hand, Mr. Stockman on Saturday night cabled hurricane warnings to Barbados, Martinique, St. Kitts, and St. Thomas. The message prognosticated a hurricane immediately, the central portion of which was south of Barbados; that it was moving north-northwesterly and increasing, with northerly winds and rains. Every one of these details has been substantiated. Fortunately, as we have seen, the warning was not required for the two more northerly of the islands notified, the hurricane abating its force somewhere in the region of St. Kitts. The Weather Bureau has distinctly shown that it can not only inform people that a hurricane has taken place after the damage is done, but can give sufficient warning beforehand to prepare masters of vessels for impending danger.

[From the Galveston and Dallas Daily News, September 25, 1898.]

The new branch of the United States Weather Bureau recently established in the West Indies has already shown the wisdom of the Government's action in that direction by the excellent warnings given relative to the development and progress of the recent destructive hurricane which made its appearance in the vicinity of Barbados and moved westward, bringing havoc to several of the Lesser Antilles. The United States fleet in those waters was kept fully advised.

During the last two days of September, 1898, a storm developed in the vicinity of Santo Domingo, and moved thence northwestward to the South Atlantic coast of the United States, where it raged with hurricane violence during October 2. Conservative estimates place the damage caused by this storm in Georgia and Florida at \$1,500,000. The value of vessels and cargoes detained by the Weather Bureau warnings of Saturday, October 1, was \$380,000, and the crews numbered 56. These were sailing vessels, and would have doubtless suffered the fate of those caught at sea. At Savannah the warnings prompted active measures for the protection of shipping and merchandise, and credit is given the warnings by representatives of business and marine interests for a saving of many thousands of dollars. At Charleston vessels and cargoes valued at nearly \$1,000,000, remained in port.

Two storms of marked intensity caused dangerous gales over the upper lakes in October, 1898. The more severe of these was centered over northern Illinois the morning of the 25th, and it moved northeastward over lower Michigan during the succeeding twenty-four hours. This storm was attended by northerly gales, which resulted in considerable damage to shipping on Lake Michigan and destroyed much property along the shore in Chicago. High winds were forecast for the upper lakes the morning of the 24th, and the forecast for lake Michigan, the morning of the 25th, was as follows:

Winds shifting to brisk and high northerly, probably becoming dangerous; rain to-night, possibly turning into snow flurries.

Vessel masters leaving port during the afternoon and evening of the 24th were cautioned that strong northerly winds would be encountered farther down the lake. Some remained in port, while others proceeded on their way, intending to seek shelter in some harbor on the west shore as soon as the storm should strike.

In referring to the work of the Weather Bureau during the severe gale which visited the Great Lakes from November 9-11, 1898, the Buffalo News of November 13, 1898, remarked, editorially, as follows:

The Government Weather Bureau has again demonstrated in the view of all the people of the Lake region its great and growing importance as a factor in the commerce and travel of the inland seas. During the past ten days the Great Lakes have been swept by a continuation of severe storms, the fury of which but few vessels could withstand, although the majority of these vessels are as large, staunch, and seaworthy as any of the ocean liners; yet but comparatively few casualties occurred, which was due to the timely warnings of the Weather Bureau, and it is no exaggeration to say that in this instance alone millions of dollars worth of merchandise, hundreds of vessels, and probably many lives have been saved by the forecasts.

One of the most disastrous storms of recent years, briefly referred to in the opening paragraph of this report, visited the Middle Atlantic and New England coasts November 26-27, 1898. At least 200 lives were lost, and fully 100 vessels wrecked along the New England coast, and railway traffic was blocked by snow. The morning of the 26th storm signals, for easterly gales, were ordered along the Atlantic coast from Eastport to Norfolk, and storm warnings for the lower lakes, including a warning of snow and a cold wave. The Bureau of Navigation, Navy Department, and the maritime exchanges of New York and Philadelphia, were informed of the action taken in notifying the marine interests of the impending severe storm of wind and snow. In addition to the above advices the following special warning was telegraphed to all Weather Bureau offices in New York and New England for distribution throughout their respective districts:

Heavy snow indicated for New York and New England to-night; notify railroad and transportation interests.

At the same hour the Pennsylvania and the Baltimore and Ohio Railroad companies were notified as follows:

A cold wave with heavy snow will prevail to-night in the Allegheny Mountain districts.

Among many editorial comments made by the daily press regarding this storm, and the action of the Weather Bureau in forecasting its destructive character, the following is from the Evening Star, Washington, D. C., November 30, 1898:

The full story of Saturday night's storm may never be told. Its deadly intensity is revealed by degrees in the wreckage which floats ashore, and perhaps in a few days some approximate estimate of the havoc then wrought on the New England coast may be approachable. Meanwhile it is clear that at least one great disaster marked the gale and that many lives were sacrificed. The steamer *Portland* went to pieces some time Saturday night or Sunday morning, so far out of her course as to show that the storm was of resistless strength, and that it was the most criminal folly for the captain to put out from port. * * * At half past 10 on Saturday morning the Weather Bureau in this city wired to all its observers along the New England coast the following order: "Hoist northeast storm signals; east to northeast gales, with heavy snow to-night."

Observers were also directed to warn all railroad and transportation interests of the coming of heavy snow throughout New England. The warning about the snow was particularly important. Often a ship can go to sea with comparative safety in the face of a storm if the air is not clouded, but when the snow is flying landmarks are obscured, lighthouses are useless, and the vessel is left to fate.

A severe storm for which ample warnings were given visited the lower lakes and the Middle Atlantic and New England coasts December 4 and 5, 1898. At Cleveland the storm was reported the severest of the season. The Weather Bureau observer at that point reported that the warnings were heeded, and that vessels and their cargoes,

valued at upward of \$800,000 were sheltered in that port. He also reported that a disregard of the warnings would have resulted in a loss of vessels and lives. On the Atlantic coast many captains heeded the storm warnings, and upward of 100 steamers and sailing vessels sought refuge at Sandy Hook and Gravesend Bay. At Long Branch the wind reached a velocity of 70 miles an hour from the east, and heavy seas carried away 160 feet of the iron pier. The signals kept many vessels in port at New York and other harbors of the North Atlantic coast, and in view of the exceptional severity of the storm many casualties were doubtless averted by the general regard given to the warnings.

FROST WARNINGS.

One of the defined duties of the Weather Bureau is to issue, for the benefit of farmers, orchardists, and gardeners, warnings of impending conditions favorable for the occurrence of damaging frost. The success which attended this line of work during the last year was very marked. The first important warnings were issued October 21, 1898, for the Middle and west Gulf States, Tennessee, and western Kentucky, and on the morning of October 22, the following special bulletin, showing that the warnings had been verified, was telegraphed to the yellow fever infected district of the South.

This morning's reports show frost generally throughout the infected district. In Alabama, eastern and northern Mississippi, and northern Louisiana the frosts were heavy and killing; in southwestern Mississippi and southern Louisiana light frost was reported. At Mobile the minimum temperature was 40° and at New Orleans 46°, the lowest previous record for the third decade of October being 34° at Mobile and 42° at New Orleans. November 18 is the earliest date on which freezing temperature has ever occurred at New Orleans, and November 2 is the earliest date of freezing temperature at Mobile.

In central Mississippi and northern Louisiana, and also in northern Alabama and northern Georgia freezing weather has occurred in the third decade of October. The earliest date of heavy frost at Mobile was November 2, 1874-1878. The earliest date of heavy frost at New Orleans was November 11, 1877.

The first heavy frost has occurred as late as December 29 at Mobile, while at New Orleans November and December have, in a number of years, failed to show the occurrence of heavy frost. The average date of first heavy frost is November 22 at Mobile, and December 7 at New Orleans. The average minimum temperatures for the region referred to range from 50° to 55° during November, with occasional periods of freezing temperature.

The occurrence of light frost Tuesday morning, supplemented by heavier frosts and lower temperature this morning, may be considered unfavorable for the further progress of the disease. Present conditions indicate frost, and temperature 40°, or slightly below, to-night in Alabama, Mississippi, and the interior of Louisiana. The temperature will probably remain for several days below the seasonal average, which is 66° at New Orleans and 65° at Mobile.

Acting upon the information contained in this bulletin, Edmond Souchon, president of the Louisiana board of health, issued the following proclamation, October 22, 1898:

Whereas, the Weather Bureau reports frosts occurring all over the State, and whereas it is a fact accepted by epidemiologists that no foci of yellow fever can be established in any place after frost is shown; therefore, be it ordained that all quarantine restrictions on traffic are hereby removed by the Louisiana State board of health, as far as it is concerned.

Referring to frost warnings issued for the sugar and trucking region about Galveston, Tex., during the early part of December, 1898, the Galveston Daily News of December 6, 1898, remarked as follows:

A heavy white frost put in its appearance yesterday morning, just as predicted by the United States Weather Bureau. While heavy white frosts occur nearly every winter on the mainland, Galveston has an average of one winter in five without

frost or freezing, and even with freezing weather heavy white frosts are uncommon on the island. Everybody looked for and made preparation for this frost, because the weather service had said it would occur. The warnings of injurious weather conditions made for this section have been so accurate of late years, and consequently of so great value to the public, that they have become a great factor with the sugar planters and truck growers, who care for their extensive crops as the Weather Bureau advises them. One feature which demonstrates their marked confidence in the warnings is that they take action to protect their crops as the warnings suggest. The different localities have systems in operation for the distribution of information. Some localities have distribution by telephone, others by mounted messenger service, and in others the planters distribute the information from one to his adjoining neighbor until all are advised.

There are few regions, if any, where the weather service can be of greater value than to this part of the country. The large sugar and truck farming interests use the warnings to such an extent that it saves them hundreds of thousands of dollars annually.

COLD WAVES.

Among the most important warnings issued by the Weather Bureau are those which give notice to agricultural and commercial interests of the approach of periods of abnormally low temperature. Warnings of this class have been particularly successful during the past year, and a not unimportant feature of the advices has been estimates of the probable continuation of injuriously low temperatures. In fact, a special effort has been made and will be sustained to afford all interests all the information regarding future weather conditions that is warranted by modern methods, appliances and skill in forecasting. The recognized accuracy of the temperature forecasts have caused them to be closely watched by various interests, and in the commercial centers movements of perishable goods are almost absolutely controlled by advices received from the Weather Bureau.

By far the most important cold wave, or series of cold waves, of the winter, crossed the country from the North Pacific to the South Atlantic coasts during the first half of February, 1899, damaging crops and fruits in the Southern States to the extent of millions of dollars. During the first eight days of the month the lowest temperatures on record were reported at points in the North Pacific coast States; from the 9th to the 12th many places in the Central, Western, and Northwestern States reported the coldest weather on record. During the 13th and 14th the cold wave overspread the Southern and Eastern States, attended on the 13th by the lowest temperature on record from the southern Rocky Mountain slope to the South Atlantic coast, by zero temperature to the Gulf coast of Alabama, and by a snowstorm of unprecedented severity in the Middle Atlantic States.

The Weather Bureau forecasts and warnings gave ample and timely notice to all interests of the advance of the cold wave, and special reports and newspaper comments gave unquestionable evidence that the warnings prompted protective measures whereby crops, live stock, and perishable goods and merchandise to the value of hundreds of thousands of dollars were saved. Along the Middle Atlantic and New England coasts the character of the storm called for the display of hurricane signals, the extreme warnings of the Bureau.

The detailed action taken in connection with this cold wave and storm and the numerous newspaper comments relating thereto, for which space can not be given here, will be found in the monthly Weather Review for February, 1899. All reports and comments bear witness to the fact that the work of the Weather Bureau in connection with this, the severest cold wave in the history of the Southern States, was as nearly perfect as the most approved methods of

disseminating warnings would permit. The amount saved by stockmen in the West and Southwest, by truck growers in the Southwest, and by fruit growers, gardeners, and orchardists in the Southern States, and more especially in Florida, is incalculable. The superintendent of the Florida East Coast Line reports that the warnings sent along his line of road, fifteen hours in advance of the cold wave, alone resulted in saving one-half of the vegetable crop, and that the value of the crop was estimated at \$1,000,000. The exceptionally severe character of the storm along the Middle Atlantic and New England coasts amply justified the special warnings sent to that section.

FLOODS.

The river and flood service did not develop any features of special interest during the year on account of the absence of great floods. There has been considerable improvement made in many of the river gauges, and the service has been extended by the establishment of several new special river stations, particularly in the South Atlantic States, where the additional stations are being conducted in cooperation with the United States Geological Survey.

There were several floods of minor importance during the winter in the South Atlantic and East Gulf States, and during the spring in the Missouri, Ohio, and lower Mississippi. The warnings issued for these floods were remarkably timely and accurate, and a vast amount of property was saved thereby.

During the next two years, if sufficient funds are available for the purpose, it is proposed to prepare a comprehensive work on the entire navigable water régime, giving a complete history of all river stations, elevations above tide water, rate of flow of water, and data for flood forecasting. It is desired to include in one publication all matters relating to river work, and all persons experienced in river work will be invited to contribute to the same. It is also proposed to measure the discharge of water at various places along the Ohio River. No work of this character has as yet been undertaken, although its importance has long been recognized. Data of this character are also greatly desired by the United States Geological Survey, and the work will be prosecuted in cooperation with that branch of the public service.

Several new special river stations should also be established during the coming year, owing to the steadily increasing requirements of the navigation interests.

WEST INDIAN SERVICE.

In my report for the fiscal year ended June 30, 1898, reference was made to the steps that had been taken looking to the organization of a storm warning service in the West Indies. The conclusion of the war with Spain and the conditions under which the United States occupies the islands of Porto Rico and Cuba are now matters of history. The storm-warning service, although primarily organized for the purpose of warning United States naval vessels of the coming of severe storms, has been continued in the interests of commerce and agriculture and strengthened wherever possible. At the close of the last fiscal year arrangements had been made for the establishment of meteorological stations at Kingston, Santiago de Cuba, Santo Domingo, St. Thomas, Barbados, Port of Spain, Curaçao, and Baranquilla, but neither men nor office equipments had been forwarded.

In time of peace the sending of men and materials to the various islands upon which it was desired to establish and maintain stations would have been attended with considerable difficulty and much delay. In time of war the difficulties were greatly increased; the time at our disposal was limited, the act making appropriation for the service not being approved until July 7, 1898, about a week from the beginning of the hurricane season. The needful instruments and supplies had to be purchased, no surplus of either being on hand. By vigorously pushing the work of equipping the stations, both in this city and in New York, it was possible, in spite of many hindrances, to start a party for Kingston, Jamaica, on July 22, 1898. This party, under the lead of Mr. W. B. Stockman, forecast official, in charge of the West India division, arrived at Kingston seven days later, but found it impossible, owing to the great number of Cuban refugees in the city, to secure office accommodations in the city proper. Suitable quarters were obtained in the suburbs, however, and an office of observation was established on August 7, 1898. On August 9 similar offices were established at Port of Spain, Trinidad; Willemstad, Curaçao; Santo Domingo, Republic of Santo Domingo; and at Santiago de Cuba, and the officials in charge began at once to forward weather reports twice daily by cable to the headquarters at Kingston.

Meteorological stations were established at Basseterre, St. Kitts, and Bridgetown, Barbados, on August 25 and 31, respectively; at Colon, United States of Colombia, on September 17; Roseau, Dominica, and San Juan, Porto Rico, on October 20 and 31, respectively. The headquarters of the service were moved from Kingston, Jamaica, to Havana, Cuba, on February 1, 1899, and stations were established on the last-named island at Cienfuegos and at Puerto Principe on April 28 and June 24, 1899. The original intention to establish stations at St. Thomas and Barranquilla was abandoned, and the station at Colon was discontinued April 30, 1899.

Immediately after the installation of meteorological observatories in the West Indies, Mr. Stockman, the official in charge, directed all efforts to speedily get into operation a complete and comprehensive system for the display of hurricane signals and the broad dissemination of information in regard to the approach, expected direction, and rate of progression, intensity, etc., of storms and hurricanes. Officials in charge of substations were called upon to report local conditions attending the approach of hurricanes and directed to correspond with all United States consuls and consular agents on the islands and in the near vicinity of their stations, and endeavor to secure their aid in disseminating these warnings to the inhabitants of the several islands and in the Spanish main at points where there are no Weather Bureau stations, the cost of transmission to be borne by the United States Government. At first it was difficult to interest the people in the warning service, since they are by nature very conservative and slow to adopt any change in their accustomed methods and mode of living. The issue of warnings of hurricanes was a most radical change, the inhabitants being accustomed to hear of these phenomena only upon their near approach. The work was unremittingly pushed forward, and resulted in the inauguration of a system capable of speedily and thoroughly disseminating storm-warning information to the uttermost parts of the several islands, enabling the general public to receive advance information in regard to the coming of hurricanes.

Many expressions of thanks and gratification have been received from local government officials and citizens for the inauguration of the service in the West Indies, and every effort has been made by those in authority to further the work of the Bureau, notably by the governor of Jamaica, who, while in London, personally called upon the honorable secretary for the colonies with a view to obtaining the very best possible service from the subsidized British cable companies in the West Indies.

Requests have also been received from United States consular officials on the islands of Haiti, Martinique, and Guadeloupe for the establishment of stations on those islands, and a plan is now under consideration to give these officials all information at our disposal, to be by them distributed to insular officials, marine interests, and to the inhabitants of the several islands.

The officials of cable companies residing in the various islands extended us every courtesy, but at first it was most difficult to obtain a proper cable communication between several islands, a number of the cable managers declining to receive our reports unless prepaid. This, however, was soon adjusted, but on account of the time of closing the cable offices, generally before 6 p. m., and not opening them until between 7 a. m. and 8 a. m., it was almost impossible to get the reports within a reasonable time. By changing the time of the evening observation to 5 p. m., and by personal interviews with the manager of the West India and Panama Telegraph Company, fairly good service was secured, yet no service could be obtained after about 7.30 p. m. Upon the personal application of his excellency the governor of Jamaica, the honorable secretary for the colonies wrote the directors of the West India and Panama Telegraph Company, calling attention to the great detriment the early closing of the cable offices in the West Indies was to the efficient transmission of reports and warnings, particularly during seasons of unsettled weather or the presence of storm conditions. Upon receipt of this communication the cable companies wired their Kingston official to confer with our representative and ascertain what action was necessary in order to render prompt and efficient service at all times, the result of said interview being that the manager and secretary of the West India and Panama Telegraph Company wrote the honorable secretary for the colonies as follows:

My directors * * * have instructed our general superintendent that when the weather report service is resumed next season, each weather report station will be advised in the terms of Mr. Stockman's remarks to keep the office open until a closing signal from Kingston is received. They believe that this will meet the case and will be satisfactory to the United States Weather Bureau in Jamaica.

Every courtesy and facility for the proper performance of the duties of this service have been accorded our representatives by the several governments of the islands where we have concluded to maintain permanent stations. There were but two islands where the local governments imposed obstacles to the installation of our observatories, and in these cases we were able to find hospitable locations in adjacent territory. But one government refused outright to allow us to place our observatory on its territory, and in this case the objection has recently been withdrawn.

The health of the men in the West India division has been remarkably good, but four having at any time been incapacitated for duty, although almost all have suffered more or less from tropical fevers

and the debilitating effects of the climate, yet the continuity of observation has been interrupted only at Santiago, due to the illness of the observer, and at Barbados, on account of the blowing away of the instruments during the hurricane of September 11 and 12.

CLIMATE AND CROP SERVICE OF CUBA AND PORTO RICO.

In the latter part of October, 1898, instructions were given to the official at San Juan, Porto Rico, to establish a climate and crop service in that island, and later similar action was taken in Cuba. Sufficient instruments and shelters of standard pattern were sent into both islands and voluntary stations established as rapidly as the cooperation of efficient observers could be secured. By the opening of the new year the issue of the Weekly Climate and Crop Bulletin had begun in Porto Rico, and similar bulletins for Cuba were first issued about the middle of May. The illness of the official in charge unfortunately interrupted the work of the Porto Rico section, which, however, was resumed in May and has since continued. Arrangements have been completed by which monthly section reports, after the standard, for both Porto Rico and Cuba, will be issued hereafter, work on the first report, that for May, 1899, for Porto Rico, being well in hand. Notwithstanding the serious difficulties which were encountered in the prosecution of the climate and crop work in these islands, due in a great measure to the fact that the Spanish language is exclusively spoken, much has been successfully accomplished, as evidenced by the fact that both sections issued weekly bulletins with regularity after the middle of May.

From the many courteous and complimentary communications that have been received and notices published in the newspapers, both on the islands and in the United States, it is evident that the efforts to establish this service have been successful and have met a popular need. As the residents of the islands become more conversant with the aims and scope of the service they will appreciate more fully what a great benefit it is, both climatologically and financially.

CONVENTION OF WEATHER BUREAU OFFICIALS.

A convention of Weather Bureau officials was held at Omaha, Nebr., October 13 and 14, 1898. In former conventions the attendance was confined mainly to employees engaged on climate and crop work, and, naturally, the deliberations of the convention were limited to that particular feature of the service. In the Omaha convention the discussions covered a wide range of subjects, all of which had an important bearing upon the practical work of the Bureau. The exchange of views and the discussion of methods indulged in were mutually helpful and stimulating. The convention was attended by eighty-three delegates, including those from the corps of voluntary observers and from the Department proper.

The beneficial results following the conventions of State weather service directors held in former years were so pronounced as to leave no room for doubt that such gatherings should not only be held at stated times, but that the privilege of attending them should not be restricted to officials engaged in any special line, as had been the case formerly. It was therefore decided, that the scope of the convention should be so extended as to cover a wider range of subjects, and that the regular station officials, as well as those in charge of

climate and crop centers, should have the privilege of taking part in the proceedings. The results attained were gratifying in the extreme. A complete report of all the papers and discussions was printed and extensively circulated.

DISCIPLINE.

The character of the Weather Bureau service is such as to require the maintenance of the strictest discipline. Observers, in addition to their regular observations taken twice daily at all stations at exactly the same time, must be alert to take and forward special observations when their instruments show the least premonition of storm formation. This is especially important in the new West Indian service. The officials, at the central office must be ready to receive and chart reports at almost any hour of the day or night, and to transmit to threatened districts warnings of marine storms, cold waves, or floods. At each port or other point from which danger warnings are distributed or danger signals displayed our representative must be held to a strict accountability for the prompt receipt and distribution of the information which many times is of the utmost importance in the saving of life and property. All who are familiar with the methods of administration in the Weather Bureau recognize the fact that each employee in the service, from the humblest to the most important official, is held to a strict accountability for the proper performance of duty.

No employee removed for cause has been reinstated, and no man has been removed except for just cause and after a full investigation. It may be well to quote from my remarks before the convention of Weather Bureau officials, which met in Omaha in October last, as follows:

I wish to speak especially of one matter which I believe is important in maintaining a kind, yet thoroughly efficient, discipline at your stations. I speak of this after an extensive experience in charge of several of the large stations of the Bureau. Allow no employee to impeach the official or personal integrity of a companion, unless the accused man is given full opportunity to answer his accuser. Do this and you will find that the harmony and efficiency of your station will be greatly improved. I desire to place all officials, both at the central office and throughout the extensive ramifications of the service, in such position that they may feel that they can go on with their work without fear that their standing may be surreptitiously attacked. I feel that your discipline to-day is of a very high standard of excellence.

I do not wish you to be harsh toward those over whom you exercise authority, but I desire that such discipline be applied as will encourage the pride of the men and exalt the spirit of the officials and yet maintain completely the authority of the official in charge. It is possible to have such discipline, and I believe that we have it in the Weather Bureau.

I would encourage all to be students. I know that most of you are. I know that many (myself included) have found the best years of their lives for study while in the weather service. The central office has outlined a course of study in which we expect every new appointee to become proficient before he can be considered eligible for advancement. It is necessary, in writing your reports, that you express yourselves in good English; it is necessary that the local forecast officials be well versed in physics and mathematics, and it is necessary that the section directors be thoroughly conversant with the processes under which plant life has its inception and makes its growth. We carefully scrutinize the qualifications of the man, his education, moral character, and the study he has made since entering the service, before we consider him for advancement.

Several years ago the right of the chief of Bureau to inquire into the moral character and the personal and social relations of a man before selecting him for an important trust was disputed. It was

claimed that he had the right only to consider the scientific character of his work, and his standing as an official. However, the right to make such inquiry was claimed, and the Secretary of Agriculture sustained it. Especially in the matter of selecting observers for advancement to the grade of section director or local forecast official it has been insisted that the official nominated to the Secretary of Agriculture for promotion to such important trust shall not only have the necessary educational qualifications and the executive ability, but that his morals, his private character, and his social affiliations shall be such as to reflect credit upon the Government service. A rigid adherence to the foregoing regulations during the last few years has resulted in giving to the Bureau a personnel of such high character as to command the confidence and respect of the many communities through which its numerous ramifications extend.

LOSS OF LIFE AND PROPERTY BY LIGHTNING.

The collection of statistics of loss of life and property by lightning, referred to in a previous report, has been continued. The number of deaths by lightning stroke in the calendar year 1898 was 367, and the number of injuries 494. The places where the proportion of deaths to total population was the greatest were the Upper Missouri Valley and portions of the Rocky Mountain region. The proportion of deaths by lightning in the United States to the total population is about five in a million, which, it may be remarked, is higher than the average of most countries.

Nine hundred and sixty-six barns, sheds, etc., 735 dwellings, stores, and office buildings, 95 churches and schools, and 70 other buildings were struck and damaged by lightning, the approximate loss being about a million and a half dollars. Of the buildings struck, 40 were provided with lightning rods, 855 were not, and in 952 cases it could not be ascertained whether the building was provided with rods or not.

Nine hundred and sixty-four head of cattle, 306 horses, 30 mules, 426 sheep, and 116 hogs were killed by lightning during the calendar year above referred to. The total value of the stock reported killed was \$48,257.

Lightning has caused great loss of life and property thus far during the calendar year 1899.

METEOROLOGICAL CHART OF THE GREAT LAKES.

Ten numbers of the meteorological chart of the Great Lakes were issued since the date of last report. The May and June, 1899, issues contained new and valuable material relating to the meteorology and hydrography of the Lake region. It is the present intention to publish such additional portions of the accumulated meteorological data for the Lake region as may be useful in the study of problems affecting the free and uninterrupted navigation of the Great Lakes and connecting waterways.

Two important points have been established by the investigation of fog during the season of 1898. First, that reports of fog from shore stations can not always be depended upon to show whether or not fog exists in midlake; fog was reported quite frequently in the fairway of vessels on the lakes, while very little was observed at land stations; second, that the wind direction appears to have but little influence on the formation of fog, especially on the upper lakes.

The formation of fog appears to be due primarily to changes of air and water temperatures, especially those that tend to produce a strong contrast between the temperature of the air and the underlying water. In confirmation of this belief it may be stated that fog appears most frequently on Lake Superior some distance from shore, where the water temperatures are low and the difference between air and water temperatures is the greatest. This is especially true of the region eastward of Keweenaw Point, where water temperatures as low as 39.5° have been observed during July and August.

AERIAL OBSERVATIONS.

At the close of the last fiscal year 17 kite stations were in operation and 248 ascensions had been made, in each of which the elevation attained exceeded 1,000 feet. The work was continued until about the middle of November, 1898, at which time 1,217 ascensions of 1,000 feet and over had been made.

The study of the records of temperature, pressure, and humidity thus secured was intrusted to Mr. H. C. Frankenfield, forecast official, whose first report has been submitted. For the first time in the history of meteorology we have facts instead of hypotheses as to the average gradient of temperature up to 6,000 or 8,000 feet, free from all injurious influences, and for so many days and over such a large region of country that it has a broad significance; evidently it is the only proper gradient to be used in reducing atmospheric pressures or temperatures, up or down, from any observer's level. Notwithstanding the imperfections attending the beginnings of any such entirely novel work, these 17 stations, with their 1,217 ascensions, in the course of six months, have probably added more to our knowledge of vertical gradients of temperature, humidity, and wind, in the daytime of summer, in the lower portion of the atmosphere, than the sum total of all that was previously known upon the subject.

INTERNATIONAL CLOUD OBSERVATIONS.

The report on the cloud observations, which were undertaken by the United States in cooperation with the International Cloud Committee, has been completed, and will be published as Part VI, Annual Report, Chief of Weather Bureau, 1898-99 (quarto volume). This work was begun in May, 1896, with observations at Washington, D. C., and at 14 secondary cooperating stations quite uniformly distributed to the eastward of the Rocky Mountains; the observations were completed in June, 1897, and the computation and discussion of the observations in June, 1899.

The report was written by Prof. F. H. Bigelow; it may be briefly summarized under four heads: (1) The execution of the scheme proposed by the international committee for the observations and publication of the results in extenso; (2) the application of the theodolite and nephoscope observations to the discussion of the cyclonic and anti-cyclonic local circulations over the United States; (3) the construction of a standard system of constants, barometric, thermodynamic, and hydrodynamic formulæ and tables for the reduction of the cloud observations; (4) the computation of the pressure, temperature, and vapor pressure and the auxiliary constants in the four stages of cloud formation, viz, the unsaturated, the saturated, the freezing, and the frozen stages, the construction of the gradient tables, the formation

of auxiliary pressure maps for daily forecast work at selected high levels, also the computation of the amount of heat required to convert an ideal adiabatic atmosphere into the one actually existing, which is the product of the sun's absorbed heat.

The primary object in making concerted observations of cloud heights and motions was to determine the direction and velocity of the horizontal motions of the air over the northern hemisphere, or so much thereof as could be profitably occupied by existing meteorological services. The analysis of the cloud motions has led to a better understanding of the circulation of the air in areas of high and low pressure and materially increased our knowledge of the general circulation. It has also given us a method of constructing weather charts at various levels above the earth's surface whereby we may institute a systematic examination of the pressure and wind systems of the various sections of the atmosphere throughout the storm region.

PLATEAU BAROMETRY.

The reduction of the actual barometric pressures taken at stations located on the Rocky Mountain plateau to sea level has always been a problem of considerable difficulty. The exact question is to discover the relation between the observed surface temperature and the mean temperature of the air column which should be substituted for the plateau. Professor Bigelow has made a series of studies on this subject, and will make a report upon it during the next year.

CLIMATE AND CROP WORK.

At the date of last report 42 climate and crop sections were in operation. At the present writing there are 44, Cuba and Porto Rico having been added during the year. Improved appliances for printing the monthly reports of section directors have now been supplied in all cases, and for the first time in the history of the weather service the monthly and annual meteorological summaries for all centers are printed on a uniform plan, and in neat, attractive style.

Three hundred and twenty-two voluntary meteorological stations were established during the year, nearly all of which were equipped with standard instruments, including a thermometer shelter. The policy of the Bureau has been to improve the instrumental equipment of existing stations rather than to direct its energies toward securing a large number of new stations.

The publication of the National Climate and Crop Bulletin, Snow and Ice Bulletin, the monthly and weekly climate and crop bulletins of the various sections, and the daily bulletins issued from 21 centers around which the corn, wheat, cotton, sugar, and rice stations are grouped, has continued throughout the year without material change.

MONTHLY WEATHER REVIEW.

The Monthly Weather Review has been edited, as heretofore, by Prof. Cleveland Abbe, and published regularly about six weeks after the end of each month. The average size of each number is about fifty pages of text and tables, accompanied by from nine to seventeen charts and illustrations. The principal objects kept in mind in publishing the review are:

(1) A full presentation of the climatological characteristics of the current month, for the use of every class of citizens, especially

those interested in agriculture, gardening, hygiene, engineering, navigation, railroad transportation, and the study and teaching of meteorology.

(2) The presentation of recent progress in the study of the atmosphere and of the ultimate physical causes of the phenomena with which we have to deal in forecasting the weather.

(3) The practical art of forecasting daily weather and monthly or seasonal climatic averages.

(4) The encouragement of the study of meteorology by every observer of the Weather Bureau, and by all students in schools, colleges, and universities.

The recognition of meteorology as a subject worthy of laborious, profound study, not merely from the climatological point of view, but especially as a most difficult problem in dynamics, is a matter of the highest importance to the future development of the work of the Weather Bureau. No matter how perfect our system of stations and reports may be, yet the officials of the Weather Bureau will fail to derive the full advantage of this unless they keep up with every step in the progress of correlated branches of science. It is very much to be desired that some system be devised by which special opportunities shall be afforded to our best men for advanced study in meteorology and physics. In the absence of any such provision, the Monthly Weather Review will seek to respond to their needs.

There is a steady increase in the number and excellence of the meteorological papers offered for publication in the Monthly Weather Review, and if the resources of our printing office would allow it, an average of from four to eight pages might be added to each number of the Review devoted to strictly technical articles presenting summaries or translations of the best recent publications bearing on the laws of meteorological phenomena. Such an addition would be highly appreciated by our own employees and by the professors of physics, mechanics, and mathematics in our universities and their students, many of whom are looking to the professors of meteorology in the Weather Bureau to take the lead in this study.

CALIFORNIA RAINFALL AND ALASKAN TEMPERATURES.

During the prevalence of severe and greatly prolonged drought in California an attempt was made by Prof. W. H. Hammon, then in charge of the San Francisco Weather Bureau office, to correlate the observed temperatures on Unga Island, Alaska, and the phenomena of rainfall in California three months later. Professor Hammon's paper, while containing a number of interesting suggestions, was not conclusive on any point, nor did it claim to be. The subject, however, was one of very great interest and possibly of practical importance to the people of the Pacific slope, and as such was referred to a board at the central office, of which Prof. Cleveland Abbe is chairman. Professor Abbe, in his preliminary report, states:

We have undertaken to collate all that is known with reference to monthly mean temperatures at stations in Alaska and its neighborhood. This extensive work is not yet complete, but is sufficiently advanced to enable me to say that the phenomena over California are not necessarily preceded by anything that happens in Alaska. In order to predict what is to happen in California a month, or even a week, in advance, we must take a wide survey of the whole atmosphere. In order to get a truer comprehension of this important subject, we have, therefore, rearranged the maps of normal mean pressure and temperature for the northern and southern hemispheres, and have included a study of these in our report upon long-range forecasting.

DISTRIBUTION OF DAILY FORECASTS, COLD-WAVE, FROST, STORM,
RAIN, AND EMERGENCY WARNINGS.

Little can be said regarding this portion of the work that would not be a repetition of statements made in previous reports. The plan of distribution followed during the year was the same as in the past, and no innovation worthy of note has been introduced. There seems to be little opportunity for improvement, except by extending and perfecting the present system.

WEATHER BUREAU BUILDING AT SAULT STE. MARIE, MICH.

The sum of \$3,000 was appropriated by the Fifty-fifth Congress for the purpose of erecting a small brick and stone building on the public reservation at Sault Ste. Marie, Mich., for the use of the Weather Bureau. The building was finished on June 26, 1899, and occupied by the Bureau on July 1, 1899. It is admirably situated for the purpose for which constructed, and especially convenient for vessel masters who may wish to learn of the weather conditions existing at any of the Weather Bureau stations on the Great Lakes.

REPORT OF THE CHEMIST.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF CHEMISTRY,
Washington, D. C., September 1, 1899.

SIR: In harmony with the requirements of your circular letter of June 27 ultimo, I beg to submit the following report of the Division of Chemistry for the fiscal year ended June 30, 1899. I also include, in accordance with your request, an outline of the work for the current year and plans for the fiscal year ending June 30, 1901.

Respectfully,

H. W. WILEY,
Chemist.

Hon. JAMES WILSON, *Secretary.*

WORK OF THE YEAR.

NEW LABORATORY BUILDING.

The work in the laboratory for the past fiscal year was interrupted somewhat by the erection of a new laboratory building. The old quarters had been found to be totally inadequate for the increasing work of the Division. It was therefore necessary either to seek new and more commodious quarters or to tear down the old building and erect a new one in its place better suited to the wants of the Division. The proprietors of the building consented to erect a new structure on plans drawn by an expert in this Division. Accordingly, at the beginning of the fiscal year, July 1, 1898, the old building was vacated. Temporary quarters were found for the force of the Division in various localities. The office work was transferred to the attic of the main building. Through the courtesy of the authorities of the Columbian University the laboratories of that institution were opened for the use of the chemists of the Division during the college vacation. As much of the material and apparatus as was necessary for the work was transferred to the Columbian University, and the laboratory work of the Division was continued there during the summer. On the opening of the college in the latter part of September, it was found necessary to vacate the laboratories, but the authorities kindly turned over for our use a room in the basement formerly used for assaying purposes. Here temporary desks were provided and the laboratory work was continued until the latter part of October, at which period our laboratory work was transferred to the Division of Soils, where facilities for carrying on the analytical work were extended by Professor Whitney until the new building was ready for occupation, toward the end of November, 1898. The laboratories in the new building, however, were incomplete, and thus the work was again retarded pending the

fitting up of the rooms and desks. Further, owing to a misapprehension in regard to the terms of rental, all work in fitting up the new laboratories was suspended during the months of April, May, and June. In spite of the inadequate facilities for laboratory work, a great deal was accomplished during the fiscal year in the following lines:

COOPERATIVE WORK WITH THE OFFICIAL CHEMISTS OF THE UNITED STATES.

The association known as the Association of Official Agricultural Chemists has been in existence for about fifteen years. This association is comprised primarily of the chemists of the agricultural experiment stations and agricultural colleges. It also admits to membership all chemists employed in the control of food or drug products by any State or municipality. This class of members includes chiefly chemists of the State and municipal boards of health and State boards of agriculture. The membership of this association is about three hundred, representing every State and Territory in the Union. The meetings of this association from the first have been held under the auspices of the Department of Agriculture, and its work has thus assumed a degree of authority which may be regarded as official.

The methods of analysis adopted by this association have been legalized by the courts in various parts of the country. The Secretary of Agriculture may be safely regarded as the patron of the association, and its work is therefore a part of the official work of the Department.

The Division of Chemistry continued during the fiscal year the collaboration with this association in its valuable work, and one of the assistant chemists of the Division acted as referee for the association on the subject of phosphoric acid. All official communications regarding this important fertilizing material during the year were therefore referred to and acted upon in the Division of Chemistry. Cooperative work was also done in connection with all the other referees of the association on all the subjects pertaining to agricultural products, soils, and fertilizers which come within the scope of its investigations.

The Chemist continues to be the secretary of the association, collects and edits its works, and prepares them for publication as bulletins of the Division of Chemistry. The chief work of this kind which was accomplished during the past fiscal year was the revision of the entire methods of analysis of the association on all of its subjects. This work is one of great magnitude and of the utmost importance to agricultural chemists, not only throughout the United States but the world. The revised edition of the methods of analysis has been published as a reprint of Bulletin No. 46, and this has been supplied to all agricultural chemical laboratories through the country. This bulletin is also accepted as authority in all parts of the world, and its contents have been reprinted in all the principal languages of science.

The happy effects of this organized effort on the part of the agricultural chemists of the United States on the results of chemical work have been so pronounced as to induce other nations to follow the example which this country has set. Other countries now have associations of agricultural chemists pursuing similar lines of investigations and reaching similar results. It is therefore possible at the

present time to compare with some degree of satisfaction the data obtained by agricultural analytical processes in various parts of the world. Previous to the formation of the American association such a comparison was impracticable. The data of analyses as obtained by different methods and processes had varied greatly on the same substances. As a result of this, there was a constant contention in regard to the character of the work, which tended to throw discredit upon it as a whole. Happily these differences have all been removed, and the data of agricultural chemical analyses now rest upon a substantial foundation and are generally accepted throughout the country without question.

In this country differences which may arise among agricultural analysts in various States are often referred to the Division of Chemistry as an arbiter, and the decision of this Division in all such cases has been universally accepted without question.

Since the courts of the country, all the agricultural colleges and experiment stations, and all the State and municipal chemists engaged in any way in the control of food products have accepted the work of the Association of Official Agricultural Chemists as final, it seems but proper that it should be recognized in some more emphatic way. This, of course, can only be done by act of Congress, either in acknowledging the association as an official adviser of the Government or in recognizing it in some way in the votes of supplies. Inasmuch as the association is unique in this respect, that it has neither a treasurer nor a fund, it does not seem necessary to recognize it in the appropriation bills, except, possibly, in the manner to be suggested further on in regard to stenographic services during its conventions.

One of the chief causes of discontent in the association heretofore has been the delay in issuing the proceedings and the methods of analysis. This has been due, almost solely, to lack of control over the stenographic and reportorial work. If a stenographer could be employed especially for reporting the conventions of the association, the proceedings could be promptly prepared for publication. It is for this reason that the small item has been inserted in the estimates for the fiscal year ending June 30, 1901, for stenographic services in connection with this association.

INVESTIGATION OF SOILS.

The study of various soils under identical conditions, referred to in the last report, has been continued with success, and data are rapidly accumulating of high scientific value, in regard to the behavior of soils of different constitution under identical conditions. This feature of the work has been sufficiently developed in preceding reports, and, since no change in the method of investigation has been introduced, it is not necessary to call further attention to the work at the present time, save, perhaps, to say that the assistants in the Division have devised more rapid and accurate methods of analysis. This is especially true with reference to the determination of potash and phosphoric acid. The thousands of analyses rendered necessary by these investigations are now dispatched with remarkable rapidity and with the highest degree of accuracy. The improvements in the methods which have been devised have been published in the chemical journals for the benefit of agricultural chemists throughout the country.

INVESTIGATION OF FOODS.

By far the greater part of the force of the Division during the past fiscal year has been employed in the investigation of food products. The particular character of foods studied has been the meat products preserved by sterilization or otherwise, and known to commerce as canned corn beef or canned roast beef. These two classes, however, do not comprise all the various kinds of canned meats or preserved meats which have been under investigation. Efforts have been made, by purchases in the open market, to secure samples of every kind of canned or preserved goods offered for sale. While it is hardly probable that we have succeeded in this, it is certain that by far the greater number which have any commercial importance has been included in our collection.

The scope of the investigation has been twofold. In the first place the chemical composition and nutritive value of the meats have been determined. This has been secured by the regular chemical analysis, as authorized by the Association of Official Agricultural Chemists, and with such additions as experience and the exigencies of the work have required. The results of these investigations have been to supply us with a definite idea of the food value of all the various products which have been examined.

In the second place, careful and systematic research has been made for preservatives of all kinds which may have been used in these meats. The attitude which the Department of Agriculture should take toward preservatives has been frequently outlined in official reports. Since, however, a great deal of misunderstanding still exists in regard to this matter, it is advisable to restate the position held by this Division in regard to this important subject. It is not regarded as a wise thing to absolutely prohibit the use of preservatives in foods. Since, however, all chemicals which have the properties of preserving foods also have a tendency to interfere with the processes of digestion, it is held to be imperative that no food should be offered for sale which contains a preservative without having this fact plainly stated upon the label of the package. Not only should the label state that the food product contains a preservative, but it should also give the name of the preservative and the quantity employed. In this way the intending purchaser is fully informed in regard to the character of the product which he buys. While it has been established that a healthy stomach can, from time to time, receive with impunity food containing small quantities of preservatives, it is by no means certain that the continued practice of ingesting preservatives in foods would not produce serious injury. On the other hand, it is also quite certain that weak or diseased stomachs may suffer temporary or permanent injury from even minute quantities of preservatives.

The work of the Division for the year past has been devoted almost exclusively to the determination of the character and quantities of different preservatives which the food products contain. An equally important work in regard to determining the effects of these preservatives on the digestive processes will be outlined under a subsequent caption of this report. The results of the work have now been tabulated and will soon be ready for publication as Part X of Bulletin No. 13.

INVESTIGATIONS IN THE CULTURE OF SUGAR BEETS AND THE PRODUCTION OF BEET SUGAR.

Under your direction, the Division of Chemistry continued during the fiscal year ended June 30, 1899, the investigation of the possibilities of extending the beet-sugar industry in the United States. To this end the Chemist was authorized to procure 20 tons of high-grade beet seed from different growers in Europe, representing the best varieties produced on that continent. These seeds were distributed mainly to the agricultural experiment stations of the various States interested in beet culture. Considerable quantities of seeds, however, were sent in response to miscellaneous requests and through Members of the Senate and House of Representatives.

In all cases, the active cooperation of the Division of Chemistry was offered in connection with the analysis of the beets. Data for planting, cultivating, and harvesting the beets were furnished to each person to whom seed was sent, and also descriptive blanks to be filled out at the time of harvesting. Franks were also furnished with which samples for analysis could be sent to the laboratory.

During the months from September to December, inclusive, a large part of the force of the Division, both clerical and chemical, was employed in this work. Many thousands of samples were received and careful analyses thereof made.

The results of this work were fruitful in defining with greater accuracy the limits of the most successful beet culture within the country. The previous work of the Division was corroborated by the data obtained, and little by little we are finding out the definite areas where beets can be most successfully grown.

In this connection, it should not be forgotten that the first attempts ever made by the Department of Agriculture to form a map showing the growth of any particular crop originated in the Division of Chemistry.¹ More than twenty years ago Dr. William McMurtrie, former Chemist, published a map showing the probable areas in the eastern part of the United States where beets could be grown successfully. This is the first biological map ever published by the Department. The Division of Chemistry has continued at intervals to elaborate this map and make it more accurate by basing it upon more scientific data. The history of beet culture in this country has been a most emphatic demonstration of the accuracy of the topographical work which has been accomplished, and all the successful beet-sugar factories in the United States at the present time are located directly within the area thus mapped out, or very near it. It is certain that no successful beet-sugar factories can be established at any great distance from the areas which have been described.

An encouraging fact in relation to the work which the Division of Chemistry has been conducting for so long in this line is that the careful beet-sugar makers of the country fully realize the value of this work and base their economic operations upon it.

MISCELLANEOUS WORK.

In the miscellaneous work of the Division various problems have been investigated, and especially the scientific problems underlying

¹Special report No. 28, "Report on the culture of the sugar beet and the manufacture of sugar therefrom in France and the United States."

the best methods of the polarization of sugars. This work has been conducted largely for the Secretary of the Treasury of the United States.

REVIEW OF WORK OF THE DIVISION FOR THE VARIOUS EXECUTIVE DEPARTMENTS.

As an illustration of the extent to which the cooperation of the Division of Chemistry has been sought by the other Departments of the Government, there is submitted below a statement showing the nature of the cooperation, the names of the Departments soliciting it, and the number of samples examined from November 28, 1896, to September 15, 1899, a period of nearly three years:

At the request of Gen. Joseph C. Breckinridge, Inspector-General of the United States Army, 46 food samples were analyzed, and the results of the analyses transmitted to the Inspector-General. The first samples were received on November 28, 1896, and the remaining portion on December 19, 1896. On January 4, 1897, 14 additional samples were received from the Inspector-General, analyzed, and the results transmitted to him.

On April 6, 1897, the Postmaster-General transmitted a sample marked "rauchsault," a proprietary article which had been offered for shipment through the mails. We were asked by the Postmaster-General to determine the character of this material, to see if it was of a poisonous, dangerous, or explosive nature, so that the Post-Office Department could have reliable data for admitting it or for excluding it from the mails. We reported as a result of our experiments that the material in question contained no poisonous matter, that it was not explosive, nor did its constitution show that it was in any way unsuited for transmission through the mails.

On April 6, 1897, we received from the War Department, from Maj. Henry G. Sharp, 7 samples of flour, which were supposed to be adulterated, with a request that they be examined. The samples, which were Indian corn and wheaten flours, were all found to be of standard composition and to be free from all adulteration.

On May 15, 1897, there were transmitted to this Division by the Secretary of Agriculture samples of shellac varnish from the Attorney-General of the United States. These samples were to be used as evidence in a suit which was brought against the Secretary of the Treasury of the United States to compel him to issue regulations permitting the free use of alcohol in the arts. It was claimed that in the samples of shellac varnish the alcohol used was denaturalized, so that it would be impossible to recover it for bibulous purposes. A thorough search was made into the subject, and it was proven to the satisfaction of the court that it would be perfectly possible to recover the alcohol from this varnish in such a state that it could be used again in the preparation of beverages. Since the law required that the alcohol be perfectly denaturalized before it could be used in the arts, it was evident in this case that no mandamus could issue compelling the Secretary of the Treasury to issue regulations for an impossible purpose. Many millions of dollars were involved in this suit, but as a result of the work performed in the chemical laboratory further prosecutions of this nature were abandoned.

On June 25, 1897, the United States Commissioner of Internal Revenue transmitted a sample of butter, which was supposed to be adulterated, with a request that a report be made thereon. The examination and report desired were made.

On October 27, 1897, samples of concentrated fruit juice were transmitted to the laboratory by the Secretary of the Treasury for examination and report. The object of this examination was to enable the appraisers of the custom-house of New York to determine the rates of duty which these concentrated fruit juices should pay. The examination and report were made to the entire satisfaction of the custom-house officials.

On August 16, 1897, a letter was received by the Secretary of Agriculture from the Secretary of the Treasury, written at the request of the minister of The Netherlands, who desired that certain Dutch sugars imported into this country, and which had been seized by the State food authorities of Ohio as having been adulterated, be examined by a chemist of the Department of Agriculture. The suspected samples of sugar were transmitted to this laboratory on September 10, and were examined in accordance with the request of the Secretary of the Treasury for the minister of The Netherlands. The sugars were found to be deeply blued, a process which is uniformly practiced by refiners, but were found not to contain any adulterants except the excess of bluing material mentioned.

On November 19, 1897, the Secretary of State addressed a request to the Secretary of Agriculture for the examination of certain butters shipped from the United States to Martinique and there condemned by the French authorities as adulterated. The butters were received by the Department on November 30, and consisted of 3 samples, the analyses of which were carefully made and the results transmitted to the Department of State. A research of this description is of the more importance because of the well-known fact that the authorities of foreign countries are disposed to apply very rigorously the rules regulating the importation of adulterated articles to all materials coming from the United States. It is important, therefore, that our articles of export be carefully examined and proven to be free of adulteration before being sent to foreign ports. Of the 3 samples mentioned, one appeared to be what is known as "process butter," namely, made from inferior butters, remelted and washed. The second sample was evidently a pure butter, no signs of adulteration of any kind having been detected. The third sample contained an abnormal quantity of water, namely, 18.42 per cent and nearly 7 per cent of carbohydrates, having the properties of liquid glucose or dextrin. The use of sugar other than milk sugar in the making of butter appears to be a growing practice, especially for butters which are intended for exportation to tropical countries. The above data are interesting, therefore, in showing the quality of butter prepared for export to tropical regions.

On December 16, 1897, 4 samples of butter, and on January 5, 1898, 18 samples of butter were received from the United States Commissioner of Internal Revenue, with a request that they be examined to determine whether or not they contained oleomargarine. The examination was duly made and reported.

On January 13, 1898, the Secretary of Agriculture received 6 samples of canceled postage stamps from the Postmaster-General, with the request that they be examined "to ascertain whether or not these stamps can be washed without destroying their surface and color, be reused and escape detection by the officials of the post-office service." An elaborate research was made in this direction, and a report was duly communicated to the Postmaster-General to the effect that "these cancellation marks have resisted every effort to make an

erasure without destroying the color of the stamp. The inks used in the cancellation appear to have oil for their basis and to contain two coloring matters, namely, lampblack and a blue dye, the latter soluble in oil or in a combination of oil and benzine. Both the blue dye and the lampblack penetrate the fiber of the paper so deeply that an erasure necessitates both a weakening of the color and an abrasion of the surface in order to completely remove all traces of the cancellation." The Post-Office Department was therefore assured that there was no possible danger of the fraudulent reissue of cancelled stamps if the cancellation was made with ink prepared after the manner described.

On January 21, 1898, the State Department transmitted to the Secretary of Agriculture a sample of oleomargarine from the United States consul at Martinique, with the request that it be examined for coloring matters. The sample was found to be colored with one of the yellow azo-dyes, commonly used for the purpose.

On January 22, 1898, 2 samples of ribbon and ink used for type-writing machines were transmitted by the Secretary of State, with a request that the character of the ink be investigated. It was found that the ink was composed of an oil serving as a basis, the coloring matters being lampblack and Prussian blue, with a small percentage of a sample of blue dye, which gave the reactions of methyl blue. Samples of writing were prepared with these inks and were submitted to the action of various reagents, many of which decolorize gallo-tannic inks instantly. The carbon of the ink is practically indestructible by any reagents which will not also destroy the paper, and the oil which forms the basis of the ink carries the finely divided carbon so deep into the tissue of the paper, even when the paper is glazed, that any attempted erasion necessitates an abrasion of the surface of the paper which can be readily detected by a lens, if not by the naked eye.

On May 3, 1898, the Secretary of the Interior submitted for examination a sample of lemon extract which was supposed to have been the cause of the death of an Indian on the Devil's Lake Reservation. The examination showed that the extract had been prepared with methyl, or wood alcohol, instead of with the ordinary ethyl, or spirit alcohol. A few months later two more deaths were caused at Ripley, W. Va., by drinking lemon extract. These deaths were evidently due to the same cause. The use of methyl alcohol in the preparation of extracts should never be permitted.

On July 14, 1898, 3 samples of inks used for cancellation purposes were submitted for examination by the Post-Office Department. It was reported that all three of the inks were very similar in composition, having a basis of an oil, with carbon, lampblack, and a blue coal-tar dye as the coloring matter. A complete quantitative examination of the inks was made and was reported to the Post-Office Department.

On July 5, 1898, a sample of baking powder was transmitted by the Secretary of War, who asked that an analysis of it be made. The analysis of the compound requested was transmitted by the Secretary of Agriculture to the Secretary of War.

On August 3, 1898, a sample of malt extract was received from the Department of Justice, which had been sent from the Indian Territory. The object of the examination was to enable United States Commissioner Bradford to know whether or not such malt extract could be legally sold on the Indian Reservation. The content of alcohol in the sample was determined, which, together with the other

data, was furnished to the United States judicial authorities for their guidance in the matter.

On August 3, 1898, the Superintendent of the United States Coast and Geodetic Survey transmitted to the Secretary of Agriculture a quantity of petroleum for the purpose of having it refined and prepared for use in the work of his office. A careful search for impurities was made and the necessary purifications performed and the refined material returned to the Coast Survey Office.

On August 3, 1898, a sample of saccharin was received from the Secretary of the Treasury for the purpose of having it identified for the guidance of the officials of the United States custom-house service. It was also requested that an opinion be given as to the desirability of prohibiting its importation. A careful research was made into American and foreign literature in regard to the medicinal properties of saccharin, and as a result of this inquiry the following recommendation was made:

In view of the prevalence of opinion just reviewed in American medical and pharmaceutical literature, it would seem both highly unnecessary and discourteous to the interests involved to prohibit the importation of saccharin at this time without giving its representatives an opportunity to present their side of the case.

Furthermore, it does not seem probable that the quantity of saccharin and allied substances prescribed by physicians and dispensed by pharmacists will greatly involve the interests of the producers, refiners, and merchants of sugar.

It was stated, however, in the report that the use of saccharin and similar sweetening agents in the preparation of foods should be strictly prohibited.

On September 27, 1898, a sample of sugar was received from the Navy Department, with a request for its examination. The request was complied with and the results of the analysis transmitted to the Navy Department.

On December 16, 1898, a sample of ink powder was received from the State Department. It was found that this ink was composed of an iron tannate compound containing some logwood. Samples of writing done with this ink were exposed to the action of sunlight for three weeks without exhibiting any signs of fading. The ink was undoubtedly as good as the ordinary iron and tannin inks and probably somewhat better, on account of the logwood which it contained.

On January 10, 1899, January 18, 1899, January 23, 1899, January 26, 1899, January 30, 1899, February 1, 1899, and February 3, 1899, various samples of canned, roast and preserved meats, canned beef, roast beef, and refrigerated beef were received from the War Department, in all 36 samples, with a request for their complete examination for preservatives and as to their nutritive properties. Careful search was made in all these samples for preservatives, but in no case was any found. Analyses to determine the nutritive properties of the samples showed that they were equal to the ordinary meats furnished in the markets. A full report was made on all these points through the Secretary of Agriculture to the War Department for the use of the commission investigating the conduct of the war with Spain.

On January 18, 1899, there were received from the Geological Survey 3 samples of soils from the forest reservation. The analyses of these samples have not yet been completed.

On February 20, 1899, there was received from the Postmaster-General a sample of medicinal tablets for the purpose of determining whether or not they should be allowed to be transmitted through

the mails. A careful examination of these tablets showed that for the purpose for which they were intended they were wholly and intentionally fraudulent. These facts were transmitted to the Post-Office Department for its guidance in the matter.

On March 10, 1899, there was received from the War Department a sample of the so-called crystallized egg for the purpose of determining its nutritive value as a part of the regular Army ration. The report of the investigation was sent to the Commissary-General of Subsistence.

On March 16, 1899, there were received from the United States Fish Commission 2 samples of water, which were promptly analyzed and the results reported.

On March 20, 1899, there were received from the War Department 7 samples of canned meats and fish for the purpose of having their nutritive values determined and to ascertain whether or not they contained preservatives. Also, from March 27 to April 8, inclusive, there were received from the War Department 36 additional samples of canned meats, fish, etc., for the purpose of determining whether or not preservatives had been employed in their preparation and for testing their nutritive value. The results of these investigations were transmitted to the commission investigating the conduct of the Hispano-American war.

On May 25, 1899, there were received from the State Department 6 samples of material used in Japan for fertilizing purposes, and sent by the United States consul at Nagasaki, Japan. The work on these samples has not yet been finished.

On June 19, 1899, there were received from the chairman of the Senate Committee on Manufactures 82 food samples to be examined for possible adulterations. The results of these examinations will be laid before the Senate committee at its next sitting.

On July 26, 1899, and August 30, 1899, there were received from the Post-Office Department 2 machines intended for refrigerating purposes, with a request that it be determined whether or not they were fraudulent, in order that letters relating to them be excluded from the mails. A careful study of the apparatus and the chemicals accompanying them showed that the claims made by their manufacturers had no justification in fact, and this report was duly transmitted to the Post-Office Department.

On September 2, 1899, there were received from the Executive Mansion 2 samples of pipe covering for use in the Executive Mansion and the greenhouses adjoining. It was requested that an examination be made of these samples of covering in order to determine whether or not they were in harmony with the specifications of the bidder. The result of these examinations has been duly reported.

On September 8, 1899, there were received from the Attorney-General 2 samples of "mist," or beer, which it was proposed to offer for sale in the Indian reservations. A request was made for an analysis, in order to determine the percentage of alcohol and other bodies contained therein, for the guidance of the Attorney-General. The data obtained were transmitted to the judge of the United States court for his information.

On September 9, 1899, there was received from the Commissioner of Fish and Fisheries a sample of well water, with a request for a complete chemical analysis of the same, which request was complied with.

On September 11, 1899, there was received from the Naval Museum of Hygiene a sample of fluid beef extract to be examined for preservatives. The examination of this sample has not yet been completed.

On September 15, 1899, there was received a request from the Secretary of the Interior for the examination of 73 samples of mineral water from the Hot Springs Reservation of Arkansas. The Secretary of Agriculture has replied to the Secretary of the Interior expressing a willingness to cooperate with him in this matter.

During the past three years many hundreds of samples of sugars have been analyzed for the Treasury Department for the purpose of enabling the Secretary of the Treasury to formulate regulations for the methods of ascertaining the duties on imported sugars. The results of the work performed by the Division of Chemistry have been accepted by the Treasury Department in the formulation of its regulations and by the Board of General Appraisers in New York in deciding an appeal from the rates of duty imposed. This collaboration is still being continued, the chief of the Division of Chemistry having been for the past three years, and still being, chairman of a committee appointed by the Secretaries of the Treasury and Agriculture for the purpose of formulating regulations governing the polarization of imported sugars, and also for the supervision of the laboratories engaged therein.

Excluding the samples of sugar during the time mentioned, it is seen from the above that in all 359 samples of materials have been submitted by the various Executive Departments to the Secretary of Agriculture, with requests that they be examined in the Division of Chemistry. It is evident, therefore, that the various Executive Departments regard the Division of Chemistry of the Department of Agriculture as holding a certain relation to them in the course of work which they have to do touching chemistry in any of its branches. It is true that many of the Executive Departments have chemical laboratories of their own, and this renders more emphatic the recognition which these Departments give to the Division of Chemistry of the Department of Agriculture in matters of public interest in which chemistry is concerned. The fact that all the Executive Departments apply directly to the Secretary of Agriculture in such matters shows that they recognize the primacy of the work done by its Division of Chemistry over all the other chemical work of the Government. This fact is illustrated in such a striking manner by the above résumé as to be of itself a sufficient reason for recognition in some special way of the standing which the Division of Chemistry has acquired through its work in the Government service.

OUTLINE OF PLANS OF WORK FOR THE CURRENT FISCAL YEAR.

The improved facilities for analytical work referred to in the first part of this report will be utilized to the fullest extent in the work which is now in progress. Briefly, the character of the work conducting during the present fiscal year is as follows:

INVESTIGATION OF SOILS.

The investigation of soils in relation to agricultural production will be continued on the lines already laid down. Cooperative work with the Division of Soils will be carried on in the same connection. Arrangements have been made between the chiefs of the Divisions of Soils and Chemistry for this work. All the chemical work of the Division of Soils will be done in the Division of Chemistry, under the immediate direction of the Chemist, in consultation and collaboration

with the chief of the Division of Soils. One chemist is already at work in this line, and another will be added on the 1st of September. It is hoped that when the laboratory is completely fitted up a separate room for this soil work can be secured.

SUGAR-BEET INVESTIGATIONS.

During the months of September, October, and November a large part of the force of the laboratory will be again employed in the analysis of sugar beets. Seeds were distributed, as indicated in the first part of the report, to all parts of the country, in the manner which has already been described. Samples of beets for analysis will begin to arrive about September 1, and during the three months following we expect to receive from 5,000 to 10,000 samples. So large a force as will be necessary to keep the work up to date will be assigned to this part of the investigation.

INVESTIGATION OF FOODS.

The chemical work in connection with the investigation of foods, their composition, nutritive properties, and adulteration, will be pushed forward as rapidly as possible. New problems are constantly arising in this connection, and attempts are made to solve them without unnecessary delay.

ANALYSES FOR THE SENATE COMMITTEE ON MANUFACTURES.

The investigations of the Senate Committee on Manufactures into the character and extent of food adulteration are awakening in Congress a lively interest on this subject, and will probably result in a national law regulating commerce in impure or adulterated foods between the States and in the Territories. The Division of Chemistry for more than fifteen years has pursued these investigations and has trained a large corps of chemists to be experts in such matters. The Senate committee, recognizing the work which has been done, has asked you to detail the Chemist of the Department as a scientific expert in these investigations, which are still continuing. It is expected that by the meeting of Congress, in December, the work of this committee will be completed and its report ready for submission. The chairman of the Senate Committee on Manufactures has procured several hundred samples of food products, purchased in the open market in various localities, and, with your approval and consent, submitted them to the Division of Chemistry for analysis. The greater part of this work, at this date, has been finished, but I am informed that it is the purpose of the chairman of the Senate committee to secure many other samples during the months of October and November for examination.

The samples of foods which have been purchased are those which are most subject to adulteration. Among these may be mentioned the various forms of jams, jellies, marmalades, and other preserved fruit products. These bodies are very commonly subject to adulteration, containing very little of the genuine product of the orchard. Many bottled beverages have also been purchased of the cheaper grades, with the special purpose of having them examined for deleterious preservatives. Among these articles may be mentioned beers,

ales, ginger ales, pops, and similar bodies. Many samples of canned soups, meat extracts, and other similar substances have also been secured for the purpose not only of determining the methods by which they are preserved, but also of ascertaining their nutritive values.

The Division of Chemistry holds itself in readiness to respond promptly to all the demands which the chairman of the Senate Committee on Manufactures may make upon it in connection with the investigations of this committee of the important subject of food adulteration.

REPRINT OF RECORD OF PREVIOUS INVESTIGATIONS.

The earlier investigations of the Department, published in the first parts of Bulletin No. 13, are out of print, but it is the purpose of the Division to bring these earlier investigations up to date and to rewrite for publication the first eight parts of Bulletin 13 as soon as possible. This work, however, on account of its magnitude, can not be accomplished rapidly, but it is hoped that one or two parts may be revised and made ready for publication during the current year.

PARIS EXPOSITION.

The Division of Chemistry proposes, under your direction, to take an active part during the current year in the preparation of the agricultural exhibit for the Paris Exposition in 1900. To this Division has been assigned the preparation of beverages of all descriptions, candies, confections, and sugars, and fertilizers. It is proposed to make an examination of each class of bodies prepared for exhibition, so that no impure or adulterated articles will be sent over. This will entail a considerable degree of analytical work upon the Division during the year.

COOPERATIVE WORK WITH THE OFFICIAL CHEMISTS OF THE UNITED STATES.

The cooperative work with the Association of Official Agricultural Chemists will be continued during the year. One of the referees and one of the associate referees are members of the Division, and cooperative work will be established with all the referees of the association. In order that the referees of the association may use the franks of the Department in distributing samples for analysis and in conducting correspondence on matters relating thereto, they have been appointed correspondents of the Department.

MISCELLANEOUS WORK.

Miscellaneous work will be continued in the investigations of problems which are of interest to agriculture as they may arise, and in collaboration with other Divisions and other Departments.

DETERIORATION OF WHEAT.

Complaints have reached the Department of the deterioration of wheat on the Pacific coast, especially in regard to its content of gluten. The Yosemite Flouring Mill, one of the largest on the Pacific coast, has addressed a letter to the Division of Chemistry asking for

cooperation in ascertaining the cause of this deterioration and the methods of restoring the wheat to its former content of gluten. With your consent and approval, I have arranged with the agricultural experiment stations of California, Colorado, Missouri, Indiana, Michigan, Kentucky, and Maryland to experiment with samples of wheat of known quality in the different climatic conditions prevailing in those States. The samples of wheat used for seed will first be carefully analyzed in the Department of Agriculture and then forwarded to the agricultural experiment stations named to be planted in different parts of the State and subjected thereby to different climatic conditions. It is evident that the deterioration complained of is due to the combined effects of soil and climate, and when the exact character and magnitude of the causes producing the deterioration are discovered we will be in a position to supply adequate relief.

I will also act on your suggestion to extend this investigation over a wider area as soon as practicable. All of the chemical work of this investigation will be done in the Division of Chemistry, while the agricultural work will be done by the agricultural experiment stations in different parts of the country. Only by chemical study can the character of the wheat kernel be ascertained, and thus it is evident that the conduct of work of this kind is properly vested in the Division most nearly related to it.

AGRICULTURAL FOOD PRODUCTS FROM FOREIGN COUNTRIES.

The Division will continue the investigations of agricultural food products from foreign countries in regard to their purity and wholesomeness. The general methods pursued in the work of the past fiscal year will be continued and extended. One of the important problems now presented is the composition of American oats in respect of their admission into foreign markets. There appears to be a disposition on the part of some of the large milling companies in Europe to discriminate against American oats, on the ground that they have not the nutritive properties of the Scottish oats. An elaborate and thorough investigation of this problem is now under way and will be pushed to completion as rapidly as possible.

COOPERATION WITH OTHER DIVISIONS.

Arrangements have been completed, in accordance with your suggestion, for the active cooperation of the Division of Chemistry with some of the other scientific Divisions of the Department during the present fiscal year. Attention has already been called to the arrangements which have been completed between the Division of Chemistry and the Division of Soils for this collaborative work. Similar arrangements are under consideration with the Division of Forestry. By reason of the fact that chemical investigations are required in almost every branch of scientific investigation relating to agriculture it is evident that the extension of this collaborative work will prove of the highest benefit to all parties concerned. In order that the status of this work may be fully established and acknowledged it seems desirable that some further action be taken toward defining the functions of the collaborators. Unity of purpose and harmony of effort are essential to the highest achievements and are required by the principles of economy. Any misunderstanding, therefore, which might arise would be productive of harm. For this reason, I have called your attention, in another part of this report, to certain changes in the title and

compensation of the chief of the Division of Chemistry in order to establish in a definite form the principles of the collaboration above outlined.

COOPERATIVE WORK WITH OTHER DEPARTMENTS.

With your approval and consent, the Division of Chemistry will continue during the present fiscal year the collaborative work with other Departments of the Government which has been carried on in the past. Chief among these investigations is the work in conjunction with the Treasury Department in relation to standards and methods of polarization of imported sugars, and other problems relating to chemical products in connection with the revenue of the Government. The collaborative work with the Treasury Department in the way of securing samples of imported food products at the different ports of entry will be continued.

The Division of Chemistry will also continue to collaborate with the Post-Office Department in matters relating to the transmission of chemicals in the mails, and also in connection with the determination of fraudulent advertisements of remedies and other bodies of a chemical nature. This widely extended collaboration with other Departments of the Government is also an additional reason for the changes in the title and status of the Chief Chemist of the Department, referred to in another paragraph.

PLAN OF WORK FOR THE FISCAL YEAR ENDING JUNE 30, 1901.

All the lines of investigation which have been mentioned in the foregoing parts of this report, it is hoped, may be continued during the fiscal year ending June 30, 1901. The special portions of the work for that year which demand your attention in the preparation of the estimates are as follows:

IMPROVEMENT IN THE COMPOSITION OF CEREALS.

The elaborate work which was conducted by the Division of Chemistry for the eight years ended in 1894 on the improvement of the sugar content of sorghum affords an illustration of what may be accomplished in the improvement in the composition of cereals. Attention has been called, in a previous part of this report, to the deterioration of the gluten content in the wheat grown on the Pacific coast. It is evident that the causes of this deterioration are to be sought for in climatic or soil influences, or both. With your approval, arrangements have already been made for beginning a study of this problem in California and some other localities. The expense attending this investigation will be slight, but still some provision should be made for meeting it. Not only in the case of wheat, but also in the case of oats, which has been mentioned, the content of protein is a factor of the highest economic importance. It is also quite certain that Indian corn may be greatly improved as a human food product by systematic efforts to increase the amount of protein which it contains.

In order that the Division of Chemistry may carefully conduct this work and make all necessary analyses and other investigations, a small sum should be set apart for this specific purpose. I therefore suggest that you ask the committee to insert in the appropriation

bill the following clause in connection with the appropriation for the Division of Chemistry:

To enable the Secretary of Agriculture to investigate the causes of the deterioration in the gluten content of wheat on the Pacific coast and in other parts of the country, and to study methods for increasing the content of valuable food constituents in wheat and other cereals, and for necessary supplies, chemical services, labor, and traveling expenses, three thousand dollars.

PERMISSIBLE FOOD PRESERVATIVES.

In the investigations which have been conducted in the adulteration of foods, the Division of Chemistry has had occasion to study the effect of preservatives from a hygienic point of view. It is evident that substances which paralyze microorganisms and thus prevent decay, when mixed with foods would have a general tendency to interfere with the fermentations which, collectively, are called digestion. On the other hand, there are certain foods or condiments, used in minute quantities, which seem to require a certain amount of preservatives in order to make them effective. Investigations of the qualities of substances proposed as preservatives show that these bodies have very different relations to digestive ferments. It seems desirable, therefore, that the Department of Agriculture should undertake an investigation which will prove of an authoritative nature to determine the question whether preservatives should ever be used or not, and if so, what preservatives and in what quantities. This determination can only be accomplished by actual experiment, continued over a sufficient length of time to reach definite results. The importance of the investigation is of such a nature as to warrant the Department in undertaking the work, and therefore I recommend that a specific appropriation be set aside for this purpose by having inserted in the appropriation bill the following clause:

To enable the Secretary of Agriculture to investigate the character of proposed food preservatives and coloring matters, to determine their relation to digestion and to health, and to establish the principles which should guide their use, for the purchase of the necessary apparatus and supplies, employment of experts and assistants in the conduct of the investigation, and for necessary labor, supplies, and traveling expenses in connection therewith, five thousand dollars.

ESTABLISHMENT OF THE OFFICE OF DIRECTOR OF CHEMISTRY.

It is evident, from the statements which have been made in the foregoing report, that the Division of Chemistry is brought into constant connection, not only with the other Divisions of the Department, but also with the other Departments of the Government. In addition to this, it should be remembered that the Division of Chemistry was the first scientific Division established in the Department, and that by right of seniority it stands at the head of all the scientific Divisions. A further consideration, which must not be lost sight of, is that in the organic act establishing the Department of Agriculture it was provided that the Commissioner of Agriculture should employ such scientific aids as might be necessary, and that they should receive the same compensation as is paid to similar officers in other Departments of the Government.

In view of all these conditions, it seems only just that some recognition should be made of the Division of Chemistry in its relations to other Divisions and other Departments. It is admitted that it would be difficult to secure at the same time for all the chiefs of scientific

Divisions in the Department of Agriculture that recognition in standing and salary which the organic law evidently intended they should receive. I believe, however, that it is an opportune time to recognize the senior Division, and this would open the way finally for the recognition of the other scientific Divisions in the order in which they were formed. The chief of the Division of Chemistry, it is evident, has duties in connection with the collaborative work already mentioned which entitle him to a further recognition, both in the name of his office and in his compensation. I venture to propose, therefore, that the title of the office be made to read in future appropriation bills "one Director of Chemistry, who shall be chief of the Division of Chemistry," in recognition both of the seniority of the establishment of his Division and the seniority of his service as chief of a scientific Division. It is now nearly seventeen years since the chief of the Division of Chemistry assumed his present office, and a term of service of that length, provided it has been of an acceptable nature, is, without argument, a cause of a just claim for some promotion. It is believed that such a recognition would meet with the approval of the other chiefs of Divisions. I suggest, therefore, that in the appropriation bill next to be submitted to Congress, the Division of Chemistry be mentioned first after the Bureaus of the Department, in order to show its seniority as a scientific Division of the Department, and that the wording of the bill be changed in the first paragraph to read as follows:

One Director of Chemistry, who shall be chief of the Division of Chemistry, and shall be director of the collaborative work arranged for between the Division of Chemistry and other Bureaus and Divisions of the Department, and of all such chemical investigations as the heads of other Departments may request the Secretary of Agriculture to make, four thousand dollars.

ENGINEERS, FIREMEN, MESSENGERS, WATCHMEN, AND CHARWOMEN.

The desirability of placing all the employees of the above classes on the general fund and not having them charged to the rolls of the strictly scientific service has been emphasized in former reports. I believe it would add much to the efficiency of the public service if the general fund for this purpose were made large enough to include all employees of this kind. At the present time the Division of Chemistry receives no benefit from the funds appropriated by Congress for the services mentioned above, but all such services are charged to the funds appropriated by Congress for the scientific investigations and other expenses of the Division. If the general fund would provide for this service the sum remaining for scientific services in connection with agricultural work would be correspondingly increased.

CLERK OF CLASS TWO.

In a former report I have called attention to the fact that the Division of Chemistry is entitled to the services of a clerk of class two. The correspondence and other clerical work of the Division have grown enormously within the past few years, and yet no additional provision has been made by Congress for increased clerical services for many years. I therefore ask that there be inserted in the appropriation bill the amount of \$1,400 for the compensation of a clerk of class two in the Division of Chemistry. The Division is clearly entitled to this increased clerical service, both on account of the magnitude of

its work and of its age. Other Divisions established subsequent to that of this Division have clerical service of this class, and justly so, and the Division of Chemistry, therefore, only asks for a proper appreciation of its clerical service in this direction.

RENT OF NEW LABORATORY BUILDING.

I have carefully gone over the expenditures, in so far as they have been accessible to me, incurred by the owners in erecting the new building now occupied by the Division of Chemistry. I have also made inquiries in regard to rentals paid for buildings used for Government purposes in various parts of the city. The result of these investigations has been to convince me that a just rental for the building now occupied by the Division of Chemistry is \$2,500 per annum. It has been agreed, I believe, to recommend a rental of \$1,800 for the building adjoining the Division of Chemistry and occupied by the Bureau of Animal Industry. A careful study of the comparative investments in the two buildings shows that on that basis the chemical laboratory is worth at least \$2,500 per annum. Inasmuch as the amount appropriated for the current fiscal year is only \$1,200 per annum, it is only justice to the owners to recommend for the deficiency bill an item of \$1,300 as additional rental for the current fiscal year in order to bring the total rental requested by the owners up to the sum mentioned, viz, \$2,500.

STENOGRAPHIC SERVICES FOR THE ASSOCIATION OF OFFICIAL AGRICULTURAL CHEMISTS.

The delays which have frequently arisen in the printing of the proceedings and method of analysis of the Association of Official Agricultural Chemists have been due largely to the impossibility of securing proper stenographic services. Since these publications are accepted as official, not only by the Department, but by the country, it is of importance that the proceedings be reported with accuracy and dispatch. I therefore recommend that an item of \$200 be inserted in the appropriation bill annually for the compensation of a stenographer for reporting the proceedings of the Association of Official Agricultural Chemists.

I believe that in the above suggestions I have presented to you the outline of the plans of work for the fiscal year ending June 30, 1901, in sufficient detail to enable you to appreciate the needs of the Division in formulating the estimates for that year.

REPORT OF THE ENTOMOLOGIST.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF ENTOMOLOGY,
Washington, D. C., September 1, 1899.

SIR: I submit herewith an executive report covering operations in the Division of Entomology for the fiscal year ending June 30, 1899, dividing it, in accordance with the directions contained in your circular letter of June 27, into the following sections:

(1) A brief report of the operations carried on during the fiscal year 1899.

(2) An outline of proposed work for the fiscal year 1900, under appropriations already made for that year.

(3) Suggestions as to work for the fiscal year 1901, for use in preparing estimates.

Respectfully,

L. O. HOWARD,
Entomologist.

Hon. JAMES WILSON, *Secretary.*

WORK OF THE YEAR.

The amount appropriated by Congress for entomological investigations (aside from the salaries provided for by the statutory roll) was \$20,000. Of this amount, there was expended the sum of \$19,681.52, leaving an unexpended balance, which was covered into the Treasury, of \$318.48. The main items of expense may be grouped as follows: Salaries of investigators and other employees, stationed for the most part in Washington, D. C., \$15,652.47; salaries of field agents, \$657.26; miscellaneous office supplies and expenses, \$1,336.86; illustrations, \$238.96; traveling expenses, \$1,795.97. Of the salaries for employees, the amount expended for scientific assistants has been \$11,380, and for clerical and other assistants, \$4,272.47.

The work of the Division may be classified, as in former years, under the following heads:

(a) Investigations upon specific injurious insects or groups of insects.

(b) Experimental work with remedies.

(c) Determination of specimens sent in by the entomologists of the State experiment stations and by other workers.

(d) General investigations of the life histories of injurious insects.

(e) Work on the geographic distribution of the injurious insects of the United States.

(f) Bibliographic work.

(g) Preparation of circulars of information.

(h) Correspondence.

(i) Work upon the exhibit of insects for the Paris Exposition.

(j) Work in apiculture.

Briefly summarized, the work of the Division under each of these heads has been as follows:

(a) INVESTIGATIONS UPON SPECIFIC INJURIOUS INSECTS OR GROUPS OF INSECTS.

WORK ON INSECTS FROM ABROAD.

In this branch of the work of the Division, which was begun by the writer in 1894 by the sending of a skilled assistant to Mexico to study the injurious insects liable to be introduced from that country into the United States, and which has been carried on continuously since, although with no great expenditure of funds, a result has been obtained during the past fiscal year which bids fair to become of great importance to certain sections of the United States. This is the successful introduction and apparent establishment of *Blastophaga grossorum*, the insect which in Mediterranean countries fertilizes the Smyrna fig, and by this complete fertilization renders it the standard dry fig of commerce. This investigation and attempt to introduce the insect was placed by the Secretary of Agriculture in charge of the writer in the winter of 1897-98, and mention was made in the writer's report for 1898 of the preliminary steps which were taken during that fiscal year. Although arrangements had been made to employ the services of a special agent to do the European end of the work, the writer was fortunate, through the courtesy of the Division of Botany, in securing for this work the services of Mr. W. T. Swingle, an agent of the Section of Seed and Plant Introduction of that Division, at that time in Europe, thus saving the expense of sending a man out for this especial purpose. Importations of wild or caprifigs from Algeria in the spring of 1899 were sent from this office to Fresno, Cal. The insects issued after arrival, laid their eggs in wild figs growing there, developed to maturity, fertilized many Smyrna figs, laid their eggs again in the second crop of wild figs, and once more developed to maturity. This is the condition of affairs at the time of the present writing. The coming winter may temporarily upset the promising aspect of the work, but even if it does, the past year's experience has shown the Department just where and how and when to secure the insects another season, which will unquestionably in the course of time give to California at least a fig industry second to none in the world.

Further work under this head was performed in the early spring of 1899, when an assistant was sent to Porto Rico to collect and study the injurious insects of that island. Large collections were made and a report on the trip will be published in one of the bulletins of the Division. Transportation for this trip was courteously furnished by the U. S. Commissioner of Fish and Fisheries. A volunteer observer is at present in Porto Rico making further studies of injurious insects.

Exchanges and correspondence on the subject of injurious and beneficial insects have been carried on with trained entomologists in many different portions of the world. Sets of injurious forms of first-class importance have been received from Australia, Japan, the Island of Mauritius, and the Island of Réunion, while further collections of equal interest and importance have been promised by observers in other countries. The importance of this line of investigation was strikingly indicated in an instance which occurred in the spring of 1899, when an insect boring in the stems of orange trees received in

California from Japan was at once recognized by comparison with specimens received some time ago from that country, and the habits of which were reported upon at that time by a temporary agent of the Division. It was thus at once determined to be a very dangerous species, and the lot of trees containing it was destroyed.

WORK UPON INSECTS DAMAGING FORESTS IN THE NORTHWESTERN STATES.

Complaints having been received from several scientific men in the Northwest of damage to forests by the work of insects, it was determined during the winter of 1898-99 to conduct a preliminary investigation into the causes of the trouble. The writer was fortunately able to secure the services of Dr. A. D. Hopkins, of the West Virginia Agricultural Experiment Station, a man who by virtue of long study of forest insects in his own State has made himself the American authority in this line of work. Dr. Hopkins was commissioned for three months, and under instructions from the Entomologist visited portions of northern California, Oregon, Washington, and Idaho, and made a careful and successful survey of forest conditions, especially with relation to damage by insects. He found many species of insects new to science, which were undoubtedly engaged in destructive work in the timber of that region, and made many observations, upon which may be based practical suggestions which will prove of value to lumbermen. His report will be published in a forthcoming bulletin of this Division.

SCALE INSECTS.

With the publication in the spring of 1898 of Bulletin No. 12, new series, of the Division of Entomology, which was entitled *The San Jose Scale* in 1896-97, the very extensive work which has been done in this country by entomologists attached to the different agricultural experiment stations and by State entomologists was summarized and brought up to date. On account of this extensive work by State officials, and from the fact that owing to earlier work by this Division the entire life history of this scale is thoroughly and generally understood, the matter of remedies having also been placed upon a sound basis by our work and that of the entomological officials of the States of Maryland, Ohio, New Jersey, and Virginia, in particular, there has been little more to do except to watch the progress of affairs. There was an extraordinary development, however, of foreign interest in this insect, following the German edict of March, 1898, which prohibited the entrance of American plants and fruit, and even of dried fruit, and which was followed during the past fiscal year by similar legislation on the part of Austria-Hungary, Switzerland, Canada, and the Cape of Good Hope, while experts from The Netherlands, Sweden, and Germany visited the United States to investigate conditions and methods of control. The prohibition of American dried fruits seemed a particularly unnecessary hardship upon American exporters, and a careful series of investigations was therefore carried on during September and October, 1898, for the purpose of determining whether it was possible for the San Jose scale to remain alive upon any fruit which had been dried by any of the methods in use in this country. The results of this experiment, the details of which were published in Bulletin 18 of this Division, were in brief to establish the fact that all scales upon such fruit are killed by each of the drying or evaporating processes. An expert sent to this country by Germany was

fortunately present during this work and subsequently reported to his Government favoring the abolition of the dried-fruit embargo.

A systematic study of the armored scale insects (the group to which the San Jose scale belongs) has been entered upon during the year. The collection of scale insects in this office is probably the most complete one in existence, and is constantly being added to. It therefore forms the best possible basis for such study. One of the assistants has been devoting himself almost entirely to this work, and has cleared up many doubtful points of ultimate practical importance. One which may specifically be mentioned is the ascertaining of the fact that a well-known European scale insect (*Aspidiotus ostreaeformis*) has been in this country unrecognized for several years, and has been widely spread through shipments from nurseries. Careful studies of the life histories of this and a number of species of scale insects have been carried on through the year.

INSECTS AS CARRIERS OF DISEASE.

The widespread attention which this important problem has attracted during the past year or so, largely through the studies of the foreign investigators, Grassi, Bignani, Koch, Manson, and Moore, and more particularly the scarcely to be avoided conclusion that flies were more or less responsible for the spread of a mild type of typhoid fever prevalent in our army camps during the summer of 1898, called the attention of the Entomologist to the fact that almost nothing is known specifically as to the insects which breed in and which frequent human excreta. He therefore, in the autumn of 1898, started an investigation along this line which has made great progress and promises early publication of the results, which will be of such a character as to enable medical men and others to speak with positiveness relative to insects having these habits, whereas before all such statements were of necessity indefinite and more or less theoretical.

Interest in this line of work has caused a great demand among medical men for the earlier publications of this Division on the subject of mosquitoes and house flies. The discovered relations between mosquitoes and the malarial germ has caused medical and bacteriological investigators in all parts of the world to enter upon this study, and this office has been frequently called upon for exact information as to the life histories and classification of mosquitoes. The point may possibly be made that work of this character is hardly appropriate to a Department of Agriculture, but our facilities for this kind of work are great and the funds are appropriated by Congress partly for the promotion of economic entomology in general, while the importance of this subject can not be questioned.

WORK ON GARDEN AND GREENHOUSE INSECTS.

The work begun in 1898 on certain insects injurious to greenhouse and other ornamental plants has been continued, and various garden pests, particularly certain species affecting cabbage and other cruciferous crops, beans and peas, strawberries and blackberries, have been studied. Careful studies have been made of the life histories of the cabbage curculio, strawberry flea beetle, rhubarb curculio, a new borer in lima beans, greenhouse leaf-tyer, violet sawfly, a new apple-tree borer from the State of Washington, and additional information concerning the smaller corn stalk borer and the imported cabbage web-worm, a pest recently introduced and at present injurious in South

Carolina, Alabama, and Georgia, has been gained. A partial report has been made upon some of the insects of this class in Bulletin 19, new series, of the Division, published in February, 1899.

INJURIOUS GRASSHOPPERS.

As in previous years, a special field agent was authorized during the summer of 1898 to visit portions of such of the Western States as are liable to be overrun by the migratory locust, or Western grasshopper. Parts of Nebraska, Colorado, Idaho, and Washington were visited in order to make a complete circle around the permanent breeding grounds of the migratory grasshopper, which were more or less accurately mapped by the United States Entomological Commission in the year following the destructive outbreak of 1874-76. Portions of North Dakota were also visited for the purpose of investigating the appearance of what was supposed to be an isolated swarm which had flown out from the permanent breeding ground. The dangerous species had been found during the summer of 1897 in western Nebraska and in Kansas, but nowhere in sufficient number to cause alarm. Other local nonmigratory species during 1898 caused a great deal of damage in western Kansas and Nebraska, but the migratory species had very little to do with it. The conclusion reached was that while damage from local species was very probable for the summer of 1899, there was little to be feared from the migratory species. A swarm which appeared in the valleys of the western slope of the Big Horn Mountains in 1895 settled down upon the James River Valley in South Dakota. In the fall of 1897 the return migration from the permanent breeding grounds began, which accounted for the finding of the insects in North Dakota in 1898. The railroad officials in that State and the agricultural college, with the assistance of the entomologist of the Minnesota Agricultural Experiment Station, did some excellent remedial work, and hundreds of bushels of grasshoppers were destroyed. The diminution in numbers, however, was not very great, and fall plowing was neglected, so that more or less damage for 1899 was predicted.

INSECTS AFFECTING THE TOBACCO CROP.

During the fiscal year there was begun and practically completed a study of the insects affecting the growing crop of tobacco and the dried product. Seventeen species were carefully studied and the results were published in an illustrated article in the Yearbook for 1898. A new system of remedial work against the most important of the tobacco insects which damage the crop in the field was confidently urged.

OTHER INVESTIGATIONS.

More work was done during the late autumn of 1898 on the Mexican cotton-boll weevil, with a view of keeping informed as to conditions and as to mapping and spread. An agent attended a large meeting of cotton planters and addressed them concerning this insect and the remedies recommended by this Division. The interest aroused by the rather severe damage done to the plantations of persons unwilling or unable to do any remedial work was so great that a much more widespread interest in the subject followed the close of the season, and the Texas legislature passed a bill establishing the office of State entomologist, and a competent man was appointed early in 1899. The

Entomologist feels so certain that the work is now in good local hands that he advises the discontinuance of the investigation by the Department unless called upon by State officials in charge of the work.

The continuation of the investigation by this Division of the work of the Gipsy Moth Committee, which has been referred to in previous reports, was left during the past fiscal year to the discretion of the Entomologist, who, by reason of the fact that during the summer of 1897 he had carefully studied the conditions and methods and had promised a full report containing his conclusions, deemed it necessary during 1898 to make but a single trip to the infested territory, which was done in October. At that time, although two new colonies had been found outside of the mapped infested region, the exterminative work had been so prompt and so thorough that he saw no reason to alter the conclusions at which he had arrived the previous year.

The death during the year of the assistant charged with the preparation of the "Report upon insects injurious to citrous trees" has still further delayed the publication of this report. This assistant, Mr. Henry G. Hubbard, was so perfectly qualified for the task from his great entomological knowledge, from his practical turn of mind, and from his long experience in Florida as a grower of citrous fruits, that it is practically impossible to fill his place. The report was left in an unfinished, not to say fragmentary, condition, but it is hoped that it may be put together in some shape for publication, although it will undoubtedly fall far short of the excellent shape in which Mr. Hubbard would have placed it.

Work upon the report on the principal insects affecting shade trees has been progressing, but its completion, as well as that of the proposed bulletin to be arranged in encyclopædic form on the principal injurious insects of the United States, has been delayed by the apparent more pressing importance of the other work referred to in previous paragraphs.

(b) EXPERIMENTAL WORK WITH REMEDIES.

So much attention has been paid to this class of work by the State experiment stations through their corps of competent workers in entomology and horticulture that there is not the same necessity at the present time for this class of work from this office that there was some years since. Nevertheless, more or less experimental work has been done upon the grounds of the United States Department of Agriculture and in the country about Washington, D. C. Experiments upon the effects of different insecticide mixtures upon the foliage of different plants have been continued, and some tests with pure kerosene, with the arsenite of copper, and with the methods of preparation of the fish-oil soaps have been made.

(c) DETERMINATION OF SPECIMENS SENT IN.

The amount of time which the Division has been obliged to spend in this class of work during the past fiscal year has been very great. Four of the scientific assistants have been obliged to devote a large share of their working hours in this way. It is work which makes no showing in our published output, but it pays the country in the long run, since it greatly facilitates the work of State officials.

(d) GENERAL INVESTIGATIONS OF THE LIFE HISTORIES OF INJURIOUS INSECTS.

During the fiscal year notes were recorded upon 578 species which had never before been studied in the insectary. The catalogue number of the biological series so studied reached June 30, 1899, 8,652.

(e) WORK ON THE GEOGRAPHIC DISTRIBUTION OF THE INJURIOUS INSECTS OF THE UNITED STATES.

This work was carried on through the year. A large number of localities have been mapped from information received from economic entomologists in different parts of the country or derived from the notebooks and correspondence of the office. Additional circulars have been sent out to all persons in the United States whose ability to determine the principal injurious insects has been considered as reasonably sure. The maps are assuming a positive value, and are constantly consulted in the office in the preparation of articles upon injurious insects, and when reasonably complete their publication will be of undoubted service not only to economic workers, but to farmers and fruit growers.

(f) BIBLIOGRAPHIC WORK.

Since the publication of Part VI of the "Bibliography of the more important contributions to American economic entomology," which brought the titles down to January 1, 1897, an assistant has been engaged in cataloguing all such articles of economic interest, and an additional part should be published during the year, which will bring the list down to January 1, 1900.

(g) PREPARATION OF CIRCULARS OF INFORMATION.

The great service which these circulars have done in the simplification of the office correspondence has encouraged the continuation of the series. Three numbers were added during the year.

(h) CORRESPONDENCE.

The correspondence was slightly heavier than during the preceding year. Rather more than 6,500 letters were written in answer to inquiries regarding injurious insects, and others were answered by circulars, as indicated in the preceding paragraph.

(i) WORK UPON THE EXHIBIT OF INSECTS FOR THE PARIS EXPOSITION.

The desirability of having an original and practical exhibit at Paris, which should be a credit to the Department, was kept constantly in mind during the year. Large collections which would help to illustrate American forms were made during the summer of 1898 and the spring and early summer of 1899. The space allotted to this Division is small, and so a large exhibit, which could easily be made to advantage, will be impossible, but certain phases at least of our work can be shown in a creditable manner.

(j) WORK IN APICULTURE.

The work in apiculture has included further observations on honey producing and continuation of the experiments of last year in the wintering of bees and tests of various methods of preventing swarming. The results thus far obtained appear in a revised edition of Bulletin No. 1, new series. Experiments in queen rearing, which promise new results of practical value, are in progress. The acquisition of the Philippine Islands has greatly increased the interest which bee keepers have long felt in the large honey bees of the far East, the so-called giant East Indian bees, and very many requests for information concerning this species and applications for queens of these bees have been received. Private enterprise has tried to import these bees into the United States in the past, but all attempts have failed, and the Department has been repeatedly requested to undertake the work.

PROPOSED WORK FOR THE FISCAL YEAR 1900.

Aside from the general investigations which the office has been prosecuting for some seasons, it is proposed during the fiscal year ending June 30, 1900, to investigate the outbreaks of local species of grasshoppers; to conduct a partial exploration of some of the suspected permanent breeding grounds of the Rocky Mountain locust, or Western grasshopper; to carry on the investigation into the insect fauna of human excreta; to complete and ship to Paris the exhibit for the exposition; to carry on, without allowing any chance of failure which can be guarded against, the work concerning the establishment of the *Blastophaga* in California, and to study on American soil the life history of this curious and important beneficial insect, a study which has never been satisfactorily perfected in Europe, although the insect has been known in Mediterranean regions for more than 2,000 years. What has been so often mentioned in this connection, moreover, must be repeated—that it is impossible at any time to anticipate special subjects for investigations which it may at any moment become necessary to make. This is one of the difficult points connected with entomological investigations. Without a very strong corps of trained employees extended investigations covering a series of seasons are always liable to be interrupted by emergencies which require immediate field study.

NEED OF INVESTIGATIONS IN THE WEST INDIES AND THE PHILIPPINES.

I wish to repeat the paragraph published in my last executive report showing the danger of the importation of an indefinite number of insects injurious to agriculture into the United States from its insular dependencies, owing to the greatly increased commercial relations which are beginning to be established. A commencement was made, as indicated above, in the spring of 1899, by an investigating trip to Porto Rico by one of the assistants in this office. The results of this trip only emphasize the point made last year to the effect that we are in comparative ignorance of insects of that island and of Cuba. With the Philippines the same condition exists. Thorough studies and complete collections of injurious insects should be made in all of these dependencies, and the earlier it is done the better.

RECOMMENDATIONS REGARDING WORK FOR THE YEAR 1901.

APICULTURE.

I wish to repeat the recommendation of a year ago, that the sum of \$2,500 be added to the lump sum of \$20,000 provided for "Entomological investigations," the added amount to be used for the purpose of experimental investigations in apiculture. The result of a recommendation of a similar nature a year ago was the introduction into the clause appropriating for entomological investigations of the words, "*Provided*, That two thousand dollars of this sum may be expended for the purpose of experimental investigations in apiculture." As a matter of fact, in previous years certain of the funds of this Division have been expended for experimental work in apiculture, since this subject comes properly under the scope of "Entomological investigations." There seems, however, to be a great demand among the bee keepers of the country for more work of this kind than the Entomologist feels justified in undertaking by means of the lump fund. In other words, there is so much work which must be done upon injurious insects that the entire sum is none too great to carry it on. If the demanded work in apiculture is done at all well, additional means must be provided for it.

Should this latter recommendation be approved and should the appropriation be made, it might be the means of importing into this country successfully one or both of the giant Indian bees which inhabit the Philippines. Bee keepers have long been anxious to have the merits of these large Indian bees investigated in the proper way, and this would create a favorable opportunity.

STUDY OF INJURIOUS INSECTS LIABLE TO BE INTRODUCED INTO THIS COUNTRY.

I wish also to repeat my recommendation of a year ago that the additional sum of \$5,000 be appropriated for the purpose of making a careful study of the insects injurious to agriculture which are liable to be introduced into this country from Cuba, Porto Rico, and the Philippines. As I have already shown, the dangers from Hawaii are infinitely less than those from Porto Rico and the dependencies named. The Southern and Southwestern States, including southern California, are liable at any time to be seriously hampered by the introduction, establishment, and spread of injurious insects from one or the other of the islands mentioned.

INCREASE OF SALARIES.

I have never before made any recommendation regarding the desirability of an increase in the salaries of the Entomologist and his principal assistants, largely on account of the feeling that a person in making such a recommendation where he is personally concerned may possibly place himself in a false light. Recently, however, facts have come to my attention regarding the salaries paid in some of the other Government offices, notably in the United States Geological Survey and the United States Coast and Geodetic Survey, to scientific employees, which indicate a radical inconsistency when these salaries are compared with those paid to the scientific workers of this Department. Men in the United States Coast and Geodetic Survey, for example, of

no greater ability, no more careful training, and no more extended experience than many of the scientific workers in this Department, are receiving from \$3,000 to \$4,000 a year, while the Agricultural Department men of the same class are receiving from \$1,800 to \$2,500 a year. I desire, therefore, to indorse the recommendations which I understand have been made by chiefs of other Divisions in former years in regard to an effort to induce Congress to raise the salaries of the chiefs of the scientific Divisions of the Department and at least their first assistants to not less than \$3,000 for the chiefs and \$2,000 or \$2,250 for the first assistants, although as a matter of fact a more just arrangement would be to make the salaries of the chiefs \$3,500 and of the first assistants \$2,500.

REPORT OF THE BOTANIST.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF BOTANY,
Washington, D. C., August 31, 1899.

SIR: I have the honor to submit herewith my seventh annual report as Botanist of the Department of Agriculture, covering the year ending June 30, 1899.

Respectfully,

FREDERICK V. COVILLE,
Botanist.

Hon. JAMES WILSON, *Secretary.*

WORK OF THE YEAR.

POISONOUS PLANTS.

The work on poisonous plants continues to be one of the most popular lines of investigation thus far undertaken by the Division of Botany. The plan of systematically investigating actual cases of poisoning, begun in 1896, has been continued. In the fiscal year 1897 thirty-four cases were investigated; in 1898, forty-one cases, and during the past year, sixty-seven cases. Of these sixty-seven cases, twenty-six pertained to farm stock and forty-one to man. The fatalities included over 4,000 head of farm animals, and at least 21 persons. Less than 20 per cent of these cases were reported by the newspaper-clipping bureaus, to which we subscribe, the rest having been brought to our attention by correspondents. The whole number of fatalities due to poisonous plants is without doubt considerably greater than is shown by our figures. Even these, however, compared with the statistics in Blyth's Text Book on Poisons, show that during the past year the death rate of human beings in the United States from poisonous plants is twice as great as the average death rate in England from the same cause. This is unquestionably due to a lack of popular knowledge about poisonous plants. Bulletin No. 20, entitled "Principal poisonous plants of the United States," issued early in the fiscal year, has done much to supply this lack. The Illinois State Board of Health republished this report in bulletin form for free distribution to the physicians of that State. In addition to the divisional bulletin, a Farmers' Bulletin, No. 86, based on the earlier publication, has been prepared, and 50,000 copies of it printed. This was republished in serial form in Merck's Market Report, and a German translation in Der Hausdokter and the Apotheker-Zeitung.

SEED-TEST LAW.

Under the authority of the law authorizing the Secretary of Agriculture to purchase seeds in the open market, test them, and in his

discretion to publish the results of the tests, including the names of the dealers, in case the seeds were below grade, several hundred tests have been made. From these it is clear that grass seed, particularly imported grass seed, requires more attention from the Department, on account of its impurities, than any other class of seeds. Up to the present time it has not seemed advisable to publish the names of any of the dealers who have been selling inferior grass seed, but warning letters have been sent them, and further tests during the coming year will show whether this method of procedure accomplishes the object for which the law was made.

TRIAL GROUNDS AT KENSINGTON, MD.

The trial grounds at Kensington, Md., have been increased in size during the past year, and now occupy 4 acres. They were used this year chiefly for variety tests of the seeds sent out last spring in the Congressional seed distribution, and for a variety test of the lettuces offered by American seedsmen. The location of these grounds at a distance of 11 miles from Washington is an inconvenience, and as soon as the area on the Potomac flats, now under the control of the Department, is brought into proper condition, the trials at present carried on at Kensington should be moved to Washington.

PLANT HOUSE.

The authority of Congress having been secured for the erection of a plant house for use in botanical investigations, plans have been prepared and a contract for the erection of the house has been made. When completed, this house will furnish ample accommodations for our germination tests of seeds, and will also serve as a packing and temporary storage place for the living plants and nursery stock imported from foreign countries.

SEED AND PLANT INTRODUCTION.

In the first year of his administration the present Secretary of Agriculture made a new departure in the Department's seed distribution by devoting a portion of the seed distribution fund to securing from northern Europe and Asia, through an agent sent abroad for that purpose, a number of drought-resistant and otherwise new or valuable agricultural plants. Later in the same year he appointed another special agent at Washington to devise a systematic scheme of seed and plant introduction. As the Division of Forestry was at that time preparing to conduct a special inquiry on the subject of trees suitable for introduction into our arid region, and had money available for the purpose, the work of this special agent was initiated in that Division. By special request of the Secretary of Agriculture the following proviso was inserted in the agricultural appropriation act taking effect July 1, 1898:

That twenty thousand dollars of the sum thus appropriated, or so much thereof as the Secretary of Agriculture shall direct, may be used to collect, purchase, test, propagate, and distribute rare and valuable seeds, bulbs, trees, shrubs, vines, cuttings, and plants from foreign countries for experiments with reference to their introduction into this country; and the seeds, bulbs, trees, shrubs, vines, cuttings, and plants thus collected, purchased, tested, and propagated, shall not be included in general distribution, but shall be used for experimental tests, to be carried on with the cooperation of the agricultural experiment stations.

The work thus specifically authorized was organized as a section of the Seed Division, with the designation, Section of Seed and Plant Introduction. At first the special agent in charge of the section was responsible directly to the Secretary of Agriculture, but to simplify administration the section afterwards, by an order of the Secretary dated October 28, 1898, was placed under the direction of the Botanist of the Department. The section as now organized consists of a corps of agricultural explorers working in foreign countries, and an office corps at Washington who receive and distribute the seed and plant importations.

During the past year four agricultural explorers have been in the field: Mr. M. A. Carleton, who visited Russia to secure superior varieties of cereals resistant to cold, drought, and fungous diseases; Dr. S. A. Knapp, who went to Japan to procure a variety of rice suitable for cultivation under the new system developed in southwestern Louisiana, and possessing in particular a high milling quality; Mr. W. T. Swingle, who investigated the agriculture of the Mediterranean region, and secured a stock of fig-fertilizing insects for the Division of Entomology, the Deglet Noor and other superior varieties of dates, and European grapes grafted on selected disease-resistant stocks, besides other important agricultural plants; and Mr. D. G. Fairchild, formerly in charge of the Washington office of the section, who in company with Hon. Barbour Lathrop, visited South America in the latter part of the year to make a preliminary survey as the basis of future agricultural exploration. Mr. Carleton, Dr. Knapp, and Mr. Swingle have returned, having successfully carried out the objects of their investigations.

INVENTORIES OF SEEDS AND PLANTS.

As the number of seeds and plants imported from foreign countries increased it became necessary, both for use in the office, and especially for the convenience of those desiring to secure seeds for experimental purposes, to have a printed catalogue or inventory of the importations. Four of these inventories, covering 2,019 numbers, have already been issued, and further inventories are in preparation. It is proposed to issue, from year to year, new inventories of the stock on hand, in which shall be incorporated, in addition to the customary data, such information as shows the success of these introductions. In this way, and by the gradual dropping out of those seeds found to be unsuccessful, the inventories will grow successively more valuable from year to year.

TESTING GARDEN ON THE POTOMAC FLATS.

The Division of Botany has long needed an area conveniently near the Department which could be used as a testing ground, and the handling of the seeds and plants introduced from foreign countries emphasized this need. In many cases the stock of seed or the number of cuttings was so small that unless the experimenter who received them was successful the original shipment might be entirely lost and the importation prove a failure. It was felt, also, that the possibility of introducing new plant diseases with the importations necessitated a quarantine station. Correspondence was therefore begun with the War Department regarding the use of a portion of the Potomac Flats, and this resulted in the enactment of the following clause in "An act

relative to the control of wharf property and certain public spaces in the District of Columbia," approved March 3, 1899:

That the Secretary of War is authorized to grant permission to the Department of Agriculture for the temporary occupation of such area or areas of Potomac Park, not exceeding a total of seventy-five acres in extent, as may not be needed in any one season for the reclamation or park improvement, the said areas to be used by the Department of Agriculture as testing grounds: *Provided*, That nothing herein contained shall be construed to change the essential character of the lands so used, which lands shall continue to be a public park, as provided in the act of Congress approved March third, eighteen hundred and ninety-seven: *And provided further*, That said area or areas shall be vacated by the Department of Agriculture at the close of any season upon the request of the Secretary of War: *And provided further*, That the entire park shall remain under the charge of the Secretary of War.

On April 8 the Acting Secretary of War issued the desired permit. The area thus occupied by the Department of Agriculture contains about 25.6 acres, and is located below the Long Bridge and along the southwest side of the Washington Channel of the Potomac. It was at once plowed and harrowed preparatory to summer fallowing.

ECONOMIC PLANTS OF THE TROPICS.

During the past year we have received a large number of inquiries about the cultivated plants of the Tropics, and these inquiries were answered by the one member of our force who is familiar with tropical agriculture. Our experience with this correspondence shows that there is a widespread interest in the United States in the subject, and a demand for correct information which is not satisfied by published works; that there is great opportunity for the application of American agricultural methods and devices in the Tropics, and that fully illustrated reports on the status of the important tropical plant products, based on the work of our own agents, is greatly needed. In the absence of means for carrying on such work in the Tropics through the members of our botanical corps, we have received and published two reports kindly placed at our disposal by others. These are Bulletin 21, "Vanilla culture as practiced in the Seychelles Islands," by S. J. Galbraith, a Scotch planter of those islands, and Circular 17, "Notes on the plant products of the Philippine Islands," by Frank H. Hitchcock, chief of the Section of Foreign Markets. I urge the securing of an appropriation for the systematic prosecution of work in this line.

PUBLICATIONS.

The publications issued during the year, in addition to reprints of earlier reports, are as follows:

Bulletins.—No. 20, Principal Poisonous Plants of the United States, by V. K. Chesnut, issued July 7, 1898; No. 21, Vanilla Culture as Practiced in the Seychelles Islands, by S. J. Galbraith, issued January 7, 1899; No. 86 (Farmers' Bulletin), Thirty Poisonous Plants of the United States, by V. K. Chesnut, issued January 14, 1899.

Circulars.—No 16, The Section of Seed and Plant Introduction, by O. F. Cook, issued February 10, 1899; No. 17, Notes on the Plant Products of the Philippine Islands, by Frank H. Hitchcock, issued June 5, 1899; No. 13 (third edition), Observations on Cases of Mushroom Poisoning in the District of Columbia, by Frederick V. Coville, issued June 10, 1899.

Report.—Report of the Botanist for 1898, by Frederick V. Coville, issued December 1, 1898.

Inventories of seeds and plants.—No. 1, Foreign Seeds and Plants imported by the Section of Seed and Plant Introduction, 1–1,000, issued April 10, 1899; No. 3, Seeds of Saccharine Sorghums distributed by the Section of Seed and Plant Introduction, issued April 21, 1899; No. 4, Cereals and Forage Plants Collected in Russia by M. A. Carleton for the Section of Seed and Plant Introduction, issued April 24, 1899.

Papers prepared for the Department Yearbook for 1898.—Weeds in Cities and Towns, by Lyster H. Dewey; Can Perfumery Farming Succeed in the United States? by Edward S. Steele; Grass Seed and its Impurities, by Gilbert H. Hicks (issued May 9, 1899, in the Yearbook, and later in the same month as separates).

CORRESPONDENCE.

It is the policy of the Division of Botany to write as few letters as possible consistently with the necessities of the work. Many inquiries are answered by marked copies of circulars or other publications of the Division. In spite of this the correspondence continues to increase as the work of the Department becomes better known throughout the country. About 6,500 letters have been written during the year. A small proportion of these were requests for information sent out by investigators in the Division, but the great majority of them were replies to questions covering a wide range of topics pertaining to plants and plant literature. There has been an increased demand for information about the cultivation of plants yielding fibers, medicines, essential oils, and rubber. The acquisition of Hawaii and Porto Rico has brought numerous requests for information about plants that may be cultivated in those islands.

REPORT OF THE ACTING CHIEF OF THE DIVISION OF BIOLOGICAL SURVEY.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF BIOLOGICAL SURVEY,
Washington, D. C., September 1, 1899.

SIR: I have the honor to submit herewith a report of the work of the Division of Biological Survey for the fiscal year ending June 30, 1899.

Respectfully,

T. S. PALMER,
Acting Chief.

Hon. JAMES WILSON, *Secretary.*

WORK OF THE YEAR.

FIELD WORK.

During the fiscal year 1898-99 field work was carried on in four States, California, Maryland, Nevada, and Texas; in two Territories, New Mexico and Alaska; and also in Mexico, British Columbia, and the Northwest Territories. In the summer of 1898 the principal work was done in northern California, and in the spring of 1899 in Texas and Alaska. At the close of the field season of 1897 a biological reconnaissance of Washington and Oregon had been nearly completed, which, in addition to previous work in southern and southeastern California, covered fully two-thirds of the Pacific States, with the exception of an area in northern California. In 1898 attention was accordingly directed to this part of California, including the region surrounding Mount Shasta from the Madeline Plains west to the Pacific, and from the Oregon boundary south to Lassen Butte. Under the personal direction of Dr. C. Hart Merriam, camps were occupied on Mount Shasta from July 15 to October 3, 1898; the peak was completely encircled, the several life zones were outlined with great care, and data were secured regarding the distribution of the characteristic mammals, birds, and plants. Side trips were made to Lassen Peak, Little Shasta Valley, and westward to the coast at Humboldt Bay. Several "zone lines" were also run from the bottom of the Sacramento and San Joaquin valleys to the summit of the Sierra or beyond; one near Quincy (latitude 40°); one along the line of the Central Pacific Railroad (latitude 39°); and one to the Yosemite Valley (latitude 37° 30'). The results of the work on Mount Shasta will be published as North American Fauna No. 16. In the spring of 1899 supplementary collections were made in Hoopa Valley, at one or two points on Humboldt Bay, at Crescent City, in Shasta Valley, and in Modoc and Lassen counties, with a view to covering the entire northern part of California, and extending the biological reconnaissance southward.

The discovery of gold in the Klondike region and at several points in Alaska has aroused general interest in the resources of that Territory, and the rush of miners and emigrants to the new gold fields has brought about rapid development in the means of communication on the Upper Yukon. Regions heretofore practically inaccessible can now be explored with comparatively little difficulty, and it was therefore deemed advisable to begin systematic field work in Alaska during the summer of 1899. An unusually favorable opportunity was presented through the liberality of Mr. Edward H. Harriman, of New York, who extended an invitation to the Biological Survey to join an expedition he had fitted out at his own expense for a trip along the Alaska coast. Dr. C. Hart Merriam with two assistants accepted this invitation, and spent two months in active field work at numerous localities, most of which are out of the regular routes of travel. The steamer *George W. Elder*, fitted up with all necessary appliances for scientific work, was chartered especially for the trip and afforded unusual facilities for the collection and preparation of material. Leaving Seattle May 31, the party proceeded northward through the inside passage to Lynn Canal and Glacier Bay, stopping at several points to collect specimens and information and visiting Victoria, Wrangel, Juneau, and Skagway. Thence the steamer sailed by way of Sitka to Yakutat Bay, Prince William Sound, Cook Inlet, Kadiak Island, the Alaska Peninsula, Shumagin Islands, and Unalaska. After leaving Unalaska a northward course was followed into Bering Sea and several points of interest were visited, including the Pribilof Islands, Plover Bay, Port Clarence, and the islands of St. Lawrence, Hall, and St. Matthew. The return trip ended at Seattle on July 30.

In addition to this work on the Alaska coast, a party in charge of Mr. W. H. Osgood was detailed to work down the Yukon River. This party left Seattle about May 24, and upon reaching Skagway took the recently completed railway over White Pass and began work at the summit of the pass. By July 1 they had reached Tagish on the headwaters of the Yukon, and as the trip down the river is expected to occupy nearly three months, they will probably reach St. Michaels, at the mouth, about the end of September. The Upper Yukon is practically an unexplored field, and the systematic study of the fauna along its whole course ought to throw much light on the northern limits of the ranges of many species. The practically simultaneous exploration of the coast and the interior also promises to afford important data for mapping the life zones of southern Alaska, which will be useful to the experiment stations located in that region.

The work of tracing the life zones in Texas was continued during the spring and early summer of 1899. A party in charge of Mr. Vernon Bailey, chief field naturalist, ran several lines near the coast and made a trip northward from the Southern Pacific Railroad across the Staked Plains to Amarilla, west to the head of the Pecos Valley, New Mexico, and thence southward to the Texas border. Prof. William L. Bray, professor of botany at the University of Texas, accompanied the party as botanist and made collections which will be of much service in working up the field notes on the distribution of species in this region.

At the request of the State geological survey of Maryland some field work was carried on in Allegany and Garrett counties, in the western part of that State, with the object of outlining the life zones of Maryland in greater detail than had previously been done, and of ascertaining especially the area which the northern zones occupy in the mountains.

ECONOMIC RELATIONS OF BIRDS.

During the year 1,381 bird stomachs were received and 1,961 were examined in the laboratory. The stomachs examined may be grouped as follows:

Flycatchers	106	Robins	127
Blackbirds	590	Miscellaneous	113
Sparrows	820		
Swallows	50	Total	1,961
Chickadees	155		

The total number of bird stomachs in the collection on June 30, 1899, was about 31,300, representing the accumulation of fourteen years. Of these, only about 14,000, or less than 50 per cent, have been examined. Arranged according to groups, the stomachs already examined are distributed approximately as follows:

Hawks and owls	3,000	Shrikes	155
Cuckoos	155	Wrens and mockingbirds	400
Woodpeckers	675	Thrushes	535
Flycatchers	360	Miscellaneous	200
Crows and jays	1,300		
Blackbirds and orioles	3,520	Total	14,000
Sparrows	3,700		

Reports have been published on all of these groups except the flycatchers, blackbirds,¹ sparrows, and thrushes. Detailed reports on hawks and owls, the crow, woodpeckers, cuckoos, and shrikes were published in the form of special bulletins, while those on the blue jay, meadowlark, Baltimore oriole, crow blackbird, house wren, brown thrasher, and catbird were condensed and presented in popular form as articles in the Yearbooks for 1895-98. Most of these investigations, except those relating to hawks and owls, have also been summarized in Farmers' Bulletin No. 54.

Special efforts have been made to complete the examination of the stomachs of sparrows and blackbirds, and to prepare the results for publication. The number of stomachs available for the report on sparrows has now increased to about 4,000, comprising 20 species and several subspecies. Each of these species is represented by at least 50, and in some cases 300, stomachs—a sufficient number to furnish reliable data respecting the bird's food habits, and to determine its value as a weed destroyer.

It is proposed to supplement the brief papers on the food of the crow blackbird, meadowlark, and oriole, published several years ago, by a report on other members of the family, including the red-winged and yellow-headed blackbirds, Brewer's blackbird, the rusty grackle, cowbird, and bobolink. Much complaint is made of the depredations of the blackbirds which breed in enormous numbers in the swamps of the Upper Mississippi Valley and destroy considerable grain in the early autumn. The material now on hand shows definitely the damage done by each species, and also the members of the group which offset their grain-eating record by destruction of insects.

In addition to the examination of stomachs in the laboratory, considerable work has been done in the field to ascertain whether birds show marked preference in selecting food or simply eat that which is most abundant or most readily obtainable. Stomach examination shows what kind of food a bird has eaten, but it is desirable to know

¹A brief paper on the crow blackbird, based on an examination of about 1,000 stomachs, was published in the Yearbook for 1894.

whether birds habitually reject other kinds of food, especially insects, which are equally abundant. In order to throw light on this question, Prof. F. E. L. Beal spent several weeks last summer in Massachusetts collecting bird stomachs and studying the available food supply in a limited area. Visits were also made to several places in New Hampshire and Vermont to learn what birds, if any, were injuring crops, more especially small fruits. Similar field work has also been carried on for practically two years at a point near Washington, D. C. A farm which is especially favorable for observation, both by reason of diversity of crops and abundance of birds, has been visited at intervals during the year, the crops noted, the birds observed, and a sufficient number of stomachs collected to show the character of the birds' food. Thus, it has been possible to determine definitely the effect of birds on the crops at each season.

PUBLICATIONS.

The past year has witnessed greater activity in publication than any previous period in the history of the Division. The publications include three bulletins (Nos. 9, 10, and 11); three numbers of North American Fauna (Nos. 14, 15,¹ and 16¹); two articles in the Yearbook for 1898; the Report of the Division for 1898; reprints of Bulletins Nos. 10 and 11, North American Fauna Nos. 10, 12, and 13, and two reprints of Farmers' Bulletin No. 54 on "Some common birds in their relation to agriculture."

The three bulletins, No. 9 on "Cuckoos and shrikes," No. 10 on "Life zones and crop zones," and No. 11 on "Geographical distribution of cereals," have already been noticed in the report for last year. Two of these bulletins, Nos. 10 and 11, were in such demand that the editions were soon exhausted and reprints were rendered necessary within ten months after publication. The three numbers of North American Fauna are as follows: No. 14, "Report of the natural history of the Tres Marias Islands, Mexico," by E. W. Nelson; No. 15, a technical "Revision of the jumping mice of the genus *Zapus*," by Edward A. Preble; No. 16, "Report on a biological survey of Mount Shasta," by Dr. C. Hart Merriam, comprising an account of the field work done in northern California during the season of 1898. One of the articles in the Yearbook, entitled "Birds as weed destroyers," by Sylvester D. Judd, contained some preliminary results of the investigation on sparrows, showing the value of these birds in consuming weed seed during the winter. Another article, on "The danger of introducing noxious animals and birds," by T. S. Palmer, was prepared for the purpose of drawing attention to the folly of indiscriminate acclimatization of exotic birds and animals, as shown by the experience, both in the United States and in other countries, with the English sparrow, the mongoose, and similar pests.

The unusual number of reprints issued shows the demand for certain publications of the Division. This demand is particularly noticeable in the case of papers on food habits of birds and general reports on geographic distribution, such as the bulletin on "Life zones and crop zones."

GEOGRAPHIC DISTRIBUTION.

The compilation and tabulation of data for mapping geographic distribution of birds have continued practically without interruption

¹ Still in press.

during the year. Similar data have also been tabulated for mammals, as far as means were available. Progress in this work is necessarily slow, both on account of the great number of species and the necessity of keeping the maps already prepared up to date.

ROUTINE WORK.

Routine work necessarily continues to occupy much of the time of the office force. About 2,000 letters were received during the year, many of them accompanied by reports, schedules, and notes, which were examined and filed for future reference. Much of the correspondence relating to reports of the Division is easily disposed of, but inquiries concerning mammals and birds require special replies which often necessitate the expenditure of considerable time in preparation. About 1,700 letters were written, several hundred schedules distributed to correspondents and migration observers, and several hundred packages received and sent out. Other regular work consists in the arrangement of reports and information received from field naturalists and correspondents, preparation and examination of accounts, care of collections, unpacking and repacking specimens received for identification, forwarding supplies to field naturalists, bibliographic work, and preparation of reports and bulletins for publication. Much of this work, such as preparing manuscript for publication and proof reading, is now done by the chief of the Biological Survey and assistants, whose time could be better employed in scientific work or original investigations. Provision has therefore been made in the estimates for 1901 for an additional assistant who shall take charge of editorial and other routine work. This addition to the office force is greatly needed and will insure greater efficiency and economy in the work.

IDENTIFICATION OF SPECIMENS.

Many specimens have been received for identification, as in former years, but the fact that the Division is willing to identify specimens of mammals and birds, and that such material can be forwarded to the Department by mail and returned free of expense to the sender, does not seem to be as generally known as it should. The farmer or the fruit grower thus has an easy way of learning the name of an unfamiliar bird which is suspected of damaging his grain or fruit and the Department is informed of injuries to crops. Notwithstanding the time consumed in making the necessary examinations, correspondents are always encouraged to send in specimens concerning which they are in doubt, as such specimens often increase the value of accompanying notes and reports. Moreover, this work tends to stimulate observation and study of the habits of animals and birds, and thus has an educational value. Many persons forward long descriptions of birds which they wish to have named, but such descriptions are often vague and omit important details, so that it is impossible to tell with certainty to what species they refer. A specimen is always more satisfactory than a description. If a skin is not available, merely the head and wings are sufficient for identification in the case of a bird, and these can be inclosed in the envelope with the letter of inquiry.

ADDRESSES.

Applications are frequently received for the delivery of addresses by members of the Division before farmers' institutes, horticultural

societies, and game associations. The presentation of papers before such meetings may properly be considered a part of the duties of the office, but the time and labor involved in this form of educational work necessarily restrict it within narrow limits. Requests of this kind, however, are complied with whenever they do not involve expense or serious interruption of regular work. During the past year five addresses were given by assistants of the Division before horticultural societies and other organizations in three States and in the District of Columbia.

NATURE STUDY IN THE SCHOOLS.

The introduction of nature study in the common schools, and the efforts of the Audubon societies in the cause of bird protection, are responsible, in large measure, for the extraordinary popular interest in bird study which has developed in the past few years. Under the leadership of the College of Agriculture of Cornell University this novel kind of school work has made wonderful progress in New York, and has also been successfully taken up in other States. Children are so easily interested in birds that elementary ornithology has deservedly become one of the most popular branches of nature study, and its introduction into the lower grades of the public school opens a wide field for teaching the economic side of the subject as well as for correcting erroneous ideas now prevalent respecting the value of certain birds. One of the first suggestions for popularizing bird study was the observance of a Bird Day in the schools. Since this suggestion was indorsed by the Department in 1894, the observance of Bird Day in connection with Arbor Day has been provided for by law in at least three States—Wisconsin, Minnesota, and Connecticut—and has been adopted by many schools in other parts of the country.

The chief obstacle to the success of bird study in the schools is the lack of requisite knowledge on the part of teachers. Ornithology, unlike botany, chemistry, or entomology, is not usually included in high school or college courses, and teachers are obliged to rely mainly on their own efforts in acquiring a knowledge of the subject. That this obstacle is gradually being overcome, is shown by the enthusiasm with which the study is taken up by those who are required to teach it. It is said that 70,000 text books on birds have been sold by New York and Boston publishers during the last six years. During the same time probably more than 200,000 copies of circulars, separate papers, and reports on birds have been distributed by the Department of Agriculture, and demands for such literature are increasing so rapidly that it is impossible to meet all requests. Nearly every paper on economic ornithology ever issued by the Biological Survey is in demand by teachers for use in their work. Reports, fresh from the press, find their way into the schools and are almost immediately utilized in instruction. More than 20,000 copies of the circular on Bird Day have been distributed, and this leaflet has been reprinted by several of the Audubon societies, thus giving it still wider circulation. The Farmers' Bulletin on "Common birds in relation to agriculture," first issued in 1896, has been reprinted six times and is still in demand in spite of the 140,000 copies already published. Other reports no doubt would be equally popular if printed in large editions, but most of the publications are issued in too small editions to admit of such wide distribution. These figures speak for themselves. Through this channel the results of investigations of the Department reach a very

large number of people, and, what is still more important, the public is becoming interested in birds and is being educated to appreciate their value to agriculture.

BOUNTIES.

Measures designed for the suppression of injurious animals and birds have been considered during the past year by the legislatures of fully one-fourth of the States of the Union. In Connecticut an effort was made to restore the bounty on foxes; in Illinois, Indiana, Michigan, and Wisconsin sparrow bounties attracted attention, and in Illinois a bounty on crows was considered; wolves were the subject of bounty measures in Colorado, Minnesota, Montana, Utah, and Wyoming; the Texas legislature struggled with the problem of exterminating prairie dogs; while on the Pacific coast Washington considered the advisability of renewing ground-squirrel bounties.

An extended discussion of wolf bounties marked the annual convention of the National Live Stock Association, held at Denver early in January, 1899, and special consideration was given to the questions of the desirability of uniform bounty laws in all the Western States and Territories, of permanency in bounty legislation, and of rewards sufficiently large to be effective. In Colorado, Minnesota, Montana, and Wyoming attempts were made to secure new wolf-bounty laws or amend old laws; and in Utah to substitute a State bounty for existing county bounties.

In Illinois and Michigan movements were set on foot to secure the repeal of the acts under which rewards are now paid for the English sparrow. Indiana and Wisconsin on the other hand considered the advisability of offering bounties for this bird. Apparently all the sparrow bills failed to pass, so that bounties remain in force in Illinois and Michigan, but are still unprovided for in Indiana and Wisconsin. This will save the State of Wisconsin, according to the estimate of one of the Milwaukee papers, an annual expense of \$30,000, although the proposed bounty was only 1 cent apiece for sparrows' heads and eggs.

In Texas certain stock raisers in the Panhandle proposed to exterminate prairie dogs by means of a bill requiring landowners to destroy all the dogs on their property on or before August 1, 1900, under a penalty not exceeding \$100 for each section of land on which the animals were allowed to remain. Fortunately for nonresident landowners the bill failed to pass. The principle of this bill was practically the same as that of the ground-squirrel legislation of California of 1872-76, which not only failed to accomplish its purpose but proved extremely expensive to some of the counties.

In Washington a bill was introduced authorizing counties to levy a special tax for the payment of bounties on ground squirrels, and an effort was made, during its consideration, to render the payment of the rewards mandatory.

In several of these cases the Department was called upon for information and statistics regarding bounty laws and their results—an indication of the desire, as well as necessity, for a more general knowledge on this subject. A brief examination of the history of bounty legislation will show how useful such information would be in saving expensive experiments whose futility has already been demonstrated. Again and again measures are enacted which have already been tried in other States without any result except to entail needless expense.

The results of the mandatory clause in the Washington ground-squirrel bill and in the Texas prairie-dog bill could be easily foretold by reference to similar legislation in California, while the result of the high bounty on wolves now demanded in several Western States can be readily foreseen from past legislation in Montana and Colorado.

Bounty legislation in the United States dates back to 1630. During these two centuries and a half more than 400 separate laws have been passed containing every conceivable provision for securing proper enforcement, avoiding fraud, and raising funds with which to pay rewards. A brief compilation or summary of these various laws (including those that have been repealed as well as those still in force), with statistics showing the expenditures involved, would enable States to profit by past experience and perhaps avoid similar failures in future. Such a work has been undertaken by this office, with the object of presenting a comprehensive survey of bounty legislation, both in the United States and in foreign countries, so that those who are called upon to enact measures of this kind may ascertain beforehand the extent to which proposed laws are likely to be effective.

MOVEMENT AGAINST THE ENGLISH SPARROW IN BOSTON.

The English sparrow has attracted unusual attention during the year on account of the efforts made in Boston by the American Society of Bird Restorers to clear the sparrows from the Common and the Public Garden. A petition was presented to the mayor requesting that steps be taken, under authority of a law passed in 1890, to reduce the number of sparrows, by destroying the nests and eggs during the breeding season, on the plea that the bird had become a public nuisance. On March 15, five men in charge of a foreman began to tear down the nests in the trees and buildings on the Common, and to close up the holes which had been used as nesting sites, in order to prevent the nests from being replaced. The work proceeded without interruption until April 5, when it was suddenly brought to a close by order of the mayor. During the three weeks the work was carried on about 1,000 sparrow eggs and 4,000 nests were destroyed and 5,000 holes were closed. No birds were killed, but it was the intention of the society to trap the birds next winter and to destroy them by various other means, which should not involve putting out poison. A careful examination of the Common on May 14 revealed the presence of about 100 nests; on May 22, 152 nests were counted, and it was estimated that less than 450 birds were breeding there.

The nest destruction aroused a storm of opposition; numerous protests appeared in the daily papers, and many persons who perhaps had never before given the matter a thought suddenly became interested in sparrow extermination, and as a consequence hundreds of letters on the subject were received by the Department. Before the work had been under way a week the bulletin on the "English sparrow" (published by this Division in 1889 in a large edition, so that a considerable number of copies were still available for distribution) became entirely exhausted, and many requests for copies remained unfilled.

Unfortunately the experiment was not continued long enough to secure definite results or to test this method of preventing the undue increase of the bird. But the movement accomplished some good, not only in Boston but in other places in Massachusetts, as well as in other States, by attracting public attention to the difficulty of dealing with the sparrow question, and showing the extent to which an imported pest may increase under favorable circumstances.

PROPOSED INTRODUCTION OF THE "KOHLMEISE" AND "BLAUMEISE."

In the autumn of 1898 much interest was manifested in the Northwest in the so-called "Kohlmeise" or great titmouse of Europe. Horticulturists in Idaho advocated the introduction of this bird on the ground that it was valuable in Germany as a destroyer of the codling moth, and hence would be a desirable addition to the bird fauna of the United States. The suggestion seemed plausible, and soon attracted wide attention through the medium of the horticultural papers on the Pacific coast. Inquiries in regard to the bird and the advisability of its introduction were received by the Department from fruit growers in Idaho, Washington, and California. Investigation has failed thus far to substantiate the claims as to the bird's usefulness, and pending further information the introduction of this species has been discouraged.

Later on it was suggested that the "Kohlmeise" was less valuable than the so-called "Blaumeise," and that in reality the latter bird was the one needed by orchardists. It is difficult to see what advantage would be gained by the acquisition of either species, as the Pacific coast already has several native titmice of the same genus. The "Kohlmeise," or great titmouse (*Parus major*), is a handsome bird, about the size of the common Eastern chickadee, but readily distinguished from any American titmouse by its markings. Like other titmice it is mainly insectivorous, but although German authors regard it as very useful, there seems to be no satisfactory evidence that it is partial to the codling moth, or in fact that it ever feeds on this insect to any great extent. On the other hand, in Great Britain, where it is a resident and generally distributed, it does not seem to hold the codling moth in check, but is accused of doing more or less damage to fruit, particularly pears and figs, and is even said to attack small and weakly birds.

The "Blaumeise" or blue titmouse (*Parus caeruleus*), is closely related to the "Kohlmeise" and is also a native of Europe. It feeds mainly on insects, and more, perhaps, can be said in its favor than in the case of the "Kohlmeise," but according to an eminent English ornithologist, even the blue titmouse "may perhaps damage fruit to a small extent" in autumn. Another English writer goes so far as to assert that during the fruit season the blue tit lives on scarcely anything else beside fruit, and is more destructive to it than all the other tits together.¹ The great danger in introducing exotic birds lies in the fact that species which are beneficial in their native haunts are likely to change their habits and become injurious in foreign lands. This fact was brought out in the paper on "The danger of introducing noxious animals and birds" in the Yearbook for 1898.

NECESSITY FOR LEGISLATION RESTRICTING INTRODUCTION OF NOXIOUS ANIMALS AND BIRDS.

Thirteen years ago attention was called to the necessity of restricting the indiscriminate importation of mammals and birds, and the recommendation was made that the introduction of exotic species should be placed under the control of the Department of Agriculture.² The necessity for some such action has become more apparent on account

¹ London Field, Vol. XCIV, p. 566, 1899.

² Ann. Rept. Dept. Agriculture for 1886, p. 258.

of the danger of introducing the mongoose into this country in consequence of the recent acquisition of Hawaii and Porto Rico and the resulting increase in the means of communication with these islands. The expedition dispatched last winter by the United States Fish Commission to Porto Rico discovered that the mongoose was not only present, but that it had spread all over the island, much as it spread over Jamaica. It was imported at San Juan about twenty years ago for the purpose of destroying rats in the cane fields, and is now regarded as a general nuisance by all except the sugar planters. In Hawaii it has long since ceased to be considered beneficial, and measures were adopted seven years ago to prevent its further increase. Although it is valuable as a destroyer of rats, its record in Jamaica shows that it is one of the worst pests that can be introduced into any country, as it does not confine its killing to small animals, but also destroys poultry, game, birds and reptiles, and even consumes some kinds of fruit. No greater calamity could befall the Southern States than the introduction of the mongoose, and no effort should be spared to prevent this animal from being brought into the United States.

Another foreign species which may perhaps prove troublesome is the European starling. This bird, liberated in Central Park, New York City, about 1877 and again in 1890, seems to have become firmly established, and is now gradually spreading up the Hudson Valley. It has also become established at Portland, Oreg., and a few individuals have been imported for the city park at Allegheny, Pa. It still remains to be seen whether the starling will become as great a pest here as it has in New Zealand, but the benefit of the acquisition of such a species is at best very doubtful.

The danger of introducing certain Old World mammals and birds is neither imaginary nor of slight importance. Experience with the English sparrow shows this clearly, but if further evidence is required it is only necessary to turn to Australia and New Zealand, which in a certain sense may be considered the experiment stations of the world in matters of acclimatization. Experiments have been made in these colonies for more than thirty years with a large number of species, and as a result it is possible to tell with great precision how certain birds and mammals are likely to behave in new surroundings. Two, at least, of the British colonies, profiting by these experiments, have taken steps to protect themselves from the evils of ill-advised acclimatization. Cape Colony in 1890 forbade the introduction of the Old World rabbit, and Western Australia, in 1893, passed her so-called "Destructive birds and animals act." Under this law the introduction of rabbits, flying foxes, English sparrows, starlings, blackbirds, and thrushes is prohibited, and additions to the list of proscribed species can be made at any time upon recommendation of the colonial bureau of agriculture. It would be folly for the United States to introduce other birds like the English sparrow, which are known to be injurious; and species that have proved injurious elsewhere should be prohibited from being brought into this country under penalties severe enough to discourage evasions of the law.

The losses which have resulted from the introduction of the rabbit, weasel, English sparrow, starling, and blackbird in New Zealand and the colonies of eastern Australia have amounted to millions of dollars. A similar fate no doubt awaits Hawaii and Porto Rico if indiscriminate acclimatization is permitted in these islands. Hawaii possesses several birds of peculiar interest which are now fast becoming extinct

through the work of the mongoose; and few of its native birds can exist with hardy species like the sparrow, mina, and starling.

In view of the immediate danger of the introduction of the mongoose and the desire now manifested to import several birds of doubtful value, I desire to renew the recommendation that the introduction of exotic mammals and birds be placed under the control of this Department. I respectfully recommend that Congress be asked to take prompt action to this end, and also to protect our island dependencies from further introduction of noxious species.

OUTLINE OF WORK FOR FISCAL YEAR ENDING JUNE 30, 1900.

Since the field work each season is necessarily planned and begun in the spring, the first few months of each new fiscal year are merely a continuation of the campaign approved during the preceding year. As already stated, explorations in Alaska and California are the most important features of the field work of 1899. The biological reconnaissance of the Pacific coast will be continued southward along the northern Coast Range region of California, and, if possible, to the southern part of that State. The topographic conditions in California are so complicated that this work must be carried on with great detail and unusual care exercised in working up the results. Consequently several years are necessary to cover an area, which, in a region uniform in character like the Great Plains or the Mississippi Valley, might be completed in a single season. Additional data will be collected for mapping the life zones in western Maryland in cooperation with the State geological survey of that State. As in past years, more or less field work will be required in small areas in different parts of the country, as the necessity for special data or further material is brought to light.

Sufficient material has now been collected to warrant undertaking an investigation of the food of flycatchers, swallows, and thrushes. In the case of the flycatchers, the proposed investigation promises interesting results. A preliminary report on the kingbird, issued in 1893, vindicated this species from the charge of doing appreciable harm in killing bees, and it is probable that the material now available will show more fully the value of the kingbird in destroying "robber flies." Little, if any, work has been done on the food of swallows. Stomach examinations will show the extent to which these birds are useful as insect destroyers. That they feed on insects is already known, but the kind of insects eaten and the benefit resulting from this destruction is now little more than conjecture.

Provision will be made, in accordance with your suggestion, to accommodate at least one student assistant in the laboratory, in case a properly qualified person is found. While the compensation of this assistant will be small, the opportunity for study and learning modern methods of work ought to attract graduates of agricultural colleges and others who desire to fit themselves for undertaking investigations in economic ornithology. Competent assistants for this branch of the office are difficult to obtain. The experiment of employing a few intelligent young men in subordinate positions and training them with a view of utilizing their services for a higher grade of work, in case they become proficient, may relieve the present difficulty, and seems well worthy of trial. With larger appropriations, two or three such assistants could be employed to advantage.

FUTURE WORK.

Reference has been made several times to lines of work which demand attention, such as cooperation with experiment stations and other agencies in conducting State biological surveys, defining more accurately the limits of life zones and their subdivisions, publication of larger and more detailed maps of life zones, and of maps showing the distribution of important mammals and birds. To enlarge on these matters would be mere repetition of what has already been said in previous reports.

For the present it is only possible to continue the investigations now under way. Further expansion or taking up new lines of work is practically out of the question until provided for by adequate appropriations. Cooperative work on State surveys is almost impossible, and demands for maps and certain publications can not be met with present resources. The point has been reached where the work can not be conducted with strict economy, for the reason that it has to be divided and carried over several fiscal years in order to come within the appropriations. Only last spring an important investigation was planned but finally deferred indefinitely for lack of sufficient funds. Such conditions neither permit economical management nor produce satisfactory results, and sometimes defer the publication of investigations so long as greatly to impair their value.

In the estimates for 1901, herewith submitted, an additional assistant at a salary of \$1,500 has been asked for, to take charge of editorial and other routine work, and the recommendation for an increase of \$5,000 in the lump fund for biological investigations has been renewed. These, with two or three minor changes, make a total increase of \$6,940. I respectfully recommend that Congress be urged to provide this increased appropriation, which is almost indispensable for the successful continuance of the work.

REPORT OF THE CHIEF OF THE DIVISION OF VEGETABLE PHYSIOLOGY AND PATHOLOGY.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF VEGETABLE PHYSIOLOGY AND PATHOLOGY,
Washington, D. C., September 1, 1899.

SIR: I have the honor to submit herewith a report of the work of the fiscal year ending June 30, 1899, together with an outline of the investigations under way and planned for the current fiscal year.

Respectfully,

B. T. GALLOWAY,
Chief.

Hon. JAMES WILSON, *Secretary.*

WORK OF THE YEAR.

NUTRITION OF PLANTS.

One of the most important lines of work of the Division, and one with which practically all others are intimately connected, is that relating to nutrition. The science of plant pathology is rapidly crystallizing, and there is nothing that will put it on a firmer basis than a study of the phenomena of life itself. The primary object of our work is to preserve and make more useful the life of the plant, and this can be done only when we fully realize the importance of the life functions themselves. After all, disease is only a manifestation of the loss of vitality, and how to prevent this loss is a problem of the greatest scientific as well as practical importance.

Closely related to nutrition is the problem of heredity and its bearing on the improvement of plants by breeding and selection. To breed scientifically, the functions of the cell itself must be better understood, otherwise the work must be looked upon as more or less empirical.

DISEASES OF TIMBER.

No systematic attempt has been made in this country to investigate the many serious diseases of timber. As soon as a tree is cut it becomes subject to the attacks of many fungi, which often cause serious losses. With a view of obtaining some preliminary data for use in inaugurating more extensive investigations, an agent has been appointed who will have for his work a study of some of the more important diseases affecting timber. It is planned to publish a preliminary report on this work during the forthcoming year. Field studies of some of the more destructive diseases are now being made and information is being collected which will be of use in determining the line of work looking toward the prevention of the troubles.

DISEASES OF FOREST AND SHADE TREES.

A study of the diseases of forest and shade trees is closely related to the work on diseases of timber. Our forest trees are becoming more and more valuable, and as a knowledge of the necessity of reforestation and allied work becomes better understood the importance of a thorough knowledge of the diseases affecting living trees grows more apparent. Many complaints about diseases are received from owners of forest and shade trees, as well as from superintendents of parks and streets. Some more or less preliminary studies have been made of the diseases of trees, and it is planned to extend these investigations with a view of assisting all desiring information on the subject. The diseases as a rule are of such a nature as to necessitate much painstaking work to discover their causes, many of them being produced by unfavorable surroundings, such as improper soil or food or the presence of noxious substances in the soil and air. To determine the causes or the combination of influences at work in such cases is usually a difficult problem, and moreover it requires much study to be able to point out the best means of remedying the troubles.

LITTLE PEACH DISEASE.

The little peach disease, which has recently appeared in the important peach-growing regions of Michigan and other States, threatens to seriously cripple the peach industry unless means of checking the trouble are found. The peach industry of Michigan alone represents a value estimated at not less than \$8,000,000, and much alarm is therefore felt at the appearance and spread of this new trouble. In order to obtain all light possible on the disease an assistant has been detailed to study it in Michigan and elsewhere. The investigations have not yet proceeded far enough to justify any definite conclusions. The trouble seems to be spreading, but owing to the extreme severity of last winter many of the trees which were only partially diseased were killed outright, hence the present summer has not been as favorable for the investigation as was last year. The assistant in charge of the work has spent several weeks in the field making a thorough examination of the trees, the object being to first determine if possible whether or not the disease is due to organisms working either beneath or above the soil. Experiments are planned to determine whether the trouble is communicable, and if so, how it is transmitted. If it is shown that it can be communicated by budding or in other ways, light will be thrown on possible means of prevention.

DISEASES OF POMACEOUS AND OTHER FRUITS.

During the year the work on the diseases of pomaceous and other fruits has been pushed as rapidly as the limited assistance available would permit. Pear blight has been especially virulent in all sections of the country, and therefore opportunity has been afforded for inaugurating further work for the purpose of determining the best means of controlling this serious trouble. The general plan of preparing a report on all diseases of pomaceous fruits has been kept in mind, and to this end facts in regard to the spread of the disease, the effects of climatic and soil conditions, etc., have been noted. Some of the most destructive diseases of fruits, such as rot of peaches, plums, and cherries, anthracnose of the grape and raspberry, etc., have not been successfully controlled, and therefore much must be done in this direction.

TRUCK AND GARDEN CROPS.

During the year further studies were made of the diseases of truck and garden crops. A number of diseases of the Irish and the sweet potato have been studied, and some important results as regards their treatment have been obtained. It was found that a serious disease of the sweet potato can be prevented by a simple treatment with formalin solution. A full account of this work will be published during the current fiscal year. Owing to the widespread interest in the diseases of Irish potatoes the Farmers' Bulletin on the diseases of this crop was entirely rewritten and published.

PLANTS UNDER GLASS.

The work on plants under glass has been continued and a number of interesting results obtained. There is a widespread and growing interest in this work, chiefly because it is carried on in such an intensive manner. So far as this Division is concerned, the practical lines of investigation which are of direct interest to growers relate to the diseases affecting such crops, the improvement of varieties by breeding and selection, the best methods of handling soil, and the most practical means of supplying proper food at the proper time. The diseases of violets, carnations, and roses have received special attention, and considerable time has been given also to diseases of such crops as lettuce, tomatoes, and melons. For the purpose of improving varieties, work has been carried on in crossing tomatoes and also lettuce and some other crops. The object of this work is not so much to produce new varieties and forms as it is to establish the principles by which such new varieties are evolved. These once established and their practical application pointed out, it is believed that growers themselves can carry on the work with great profit.

DISEASES OF COTTON.

The Division has from time to time received complaints relative to serious diseases of cotton in various parts of the South. The most troublesome disease is the one affecting the sea island cotton, which, as is well known, is grown principally on the islands lying off the coast of South Carolina. This cotton is exceedingly valuable, and the lands on which it can be grown successfully are in great demand. It has been selected so thoroughly that it is now of a high standard, and as a rule commands a much better price than the ordinary kinds. Owing to a slight increase in the funds of the Division, it has been possible this year to inaugurate some preliminary experiments with a view of discovering means of preventing the disease of the sea island cotton. It has already been shown that the trouble is due to a fungus which attacks the roots of the plants, and occurs not only on cotton, but also on other crops when grown in the infected soil. This fungus has great vitality and may live in the soil for years and attack cotton when again planted there. It is probable that there may be an intimate connection between the soil conditions and the fungus itself, and in order to obtain satisfactory information in regard to the manner in which the fungus works, it may be necessary ultimately to make a thorough investigation of soil conditions and their relation not only to the plant, but also to the fungus. An assistant has been sent to the sea island cotton region and will spend several

months there making preliminary studies, with a view of undertaking more extensive work another season. In connection with this work it is proposed to inaugurate some experiments in breeding cotton which will have for their object the improvement of the varieties now grown, both as regards marketable qualities and ability to resist various diseases. This work is more fully described under the head "Plant breeding."

CEREALS AND CEREAL DISEASES.

Owing to the fact that the assistant who has charge of this work was detailed to the Section of Seed and Plant Introduction for the greater part of the year, no extended advances were made along this line. During his travels, however, the assistant visited Russia and other wheat-producing countries, and in addition to collecting for the section large quantities of cereals for distribution, he found and brought back many varieties to be used as a basis for further work in the improvement of our forms. He also obtained many facts in regard to the diseases of cereals and the relation of climatic conditions to varieties, cultivation, etc. A bulletin on cereal rusts has been prepared and published.

CURING AND FERMENTATION OF TOBACCO.

In pursuance of a plan made last year, extensive work on the curing and fermentation of tobacco has been inaugurated. This work is being carried on in cooperation with the Division of Soils, which was authorized by Congress to make a careful study of tobacco. Recognizing the importance of the work on curing and fermentation, it was determined early in the year to obtain the services of an expert capable of undertaking the investigations and pushing them as soon as possible to a successful issue. The primary object of the work is to determine, if possible, the cause of the peculiar flavor and texture in different kinds of tobacco and the possibility of controlling these in the finished product. Many of our best types of tobacco owe their high quality to the peculiar aroma they possess, and it is of the greatest importance to have definite facts as to the origin of these, as well as information bearing on the possibility of controlling them artificially. Some preliminary work was carried on in Florida, where advanced methods have been adopted for the curing and fermentation of tobacco, and a report on the subject has been published. Further work has been inaugurated in Connecticut, and it is planned to continue and extend the investigations in Pennsylvania and other sections.

The assistant engaged in this work has been detailed to the Division of Soils, and directed to cooperate with its chief in all branches of the work on tobacco.

PURE YEASTS FOR FERMENTING WINES.

Some important advances have recently been made in the use of pure yeasts for the production of grape, apple, berry, and other wines. Ordinarily fermentation in the juices is brought about by the organisms occurring on the fruits themselves, and these organisms are often of such a nature as to seriously interfere with the production of high-class wines. By using a large quantity of a yeast known to be pure, the difficulties resulting from the presence of undesirable organisms can be overcome. During the year the Section of Seed and Plant

Introduction placed at our disposal some yeasts obtained in Germany by an agent of the Department. Cultures of these yeasts were made to determine their purity, and after this some preliminary experiments were inaugurated to determine their effects on the fermentation of cider. The different forms of yeasts were found to possess distinctive characteristics as far as the production of flavor and bouquet are concerned. It is too early to give any conclusions as to the value of these yeasts, as they have not been tried here on a sufficiently large scale to test them thoroughly.

EXPERIMENTS WITH FUNGICIDES.

During the year some preliminary experiments were inaugurated with a view of determining the effect of the accumulation of copper in the soil. Copper sulphate now forms the basis of nearly all the fungicides used, and the question has arisen as to the effect of the continued use of this substance on the soil. It has been shown that the accumulation of relatively small quantities of copper will in a comparatively short time render soil sterile, and it is possible that by the continued use of a fungicide containing copper the soils of a given region may be rendered unfit for cultivated crops. The experiments inaugurated were planned to settle this point, but owing to the nature of the work it will be a number of years before any practical conclusions can be reached. In the meantime efforts will be made to discover some effective fungicides which shall not contain copper. It is possible that fungicides may be discovered which may be rendered harmless by chemical changes taking place when they reach the soil or else be changed into substances which will become available as plant food.

SPRAYING APPARATUS.

During the past few years rapid advances have been made in the improvement of spraying devices. There are still demands, however, for certain kinds of apparatus which manufacturers, as a rule, have not seen fit to supply. It is always difficult to convince manufacturers of the importance of having simple forms of apparatus, except by making such forms and showing them their practical application. During the year the Division devised a simple hand-spraying apparatus, which is intended for use where spraying is to be done on a small scale. There are many growers in the country who have only a few plants to treat, and they do not care to go to the expense of purchasing a costly apparatus for the purpose. The object of the hand sprayer is to meet such wants, and in order to get it before the public a circular describing it was issued. It is very important also that some simple and comparatively inexpensive device be perfected whereby steam or some other power may be used in spraying. A number of such apparatus can now be obtained, but the expense involved in manufacturing them is so great as to make them unavailable, except where the apparatus is purchased by cities or corporations. The gasoline motors connected with pumps are useful, but aside from their expense they are objectionable for a number of reasons.

Experiments have been under way during the year with a view of perfecting a steam spraying apparatus which can be sold at a reasonable cost, and which can be used not only for spraying, but also for many other purposes connected with farm work, such as pumping water, grinding feed, cooking cattle food, etc.

INSPECTION OF PLANTS AND SEEDS.

During the year considerable time was devoted to the inspection of plants and seeds introduced from various countries for the purpose of distributing them in this country through the Section of Seed and Plant Introduction. It is of the highest importance that all plants and seeds brought in in this way shall be carefully inspected and, if necessary, treated, so that no serious fungous or other parasites may be distributed with them. Although this work entails considerable labor, it must be done, otherwise the Department might be censurable for bringing into the country diseases which may become widespread and destructive. It is of course impracticable to be absolutely certain in all cases in inspection and treatment of stock of this kind, but still it is feasible to carry on treatment in a number of cases, and wherever it can be done every effort should be made to do it as thoroughly as possible. During the year the Division inspected and treated the following:

	Bushels.		Bushels.
Rice	290	Oats	32
Wheat	90	Buckwheat	15
Rye	40	Spelt	24
Barley	1 $\frac{3}{4}$	Millet	27 $\frac{1}{2}$

All this seed was treated by the hot-water process, and the work was done as thoroughly as possible. A number of orange trees received from Japan were inspected and found to be infected with several destructive fungi. The trees were severely cut back and placed in the greenhouse for further inspection before sending them out. A number of other plants also were inspected. Some of them were treated with fungicides and sent out, but others were destroyed on account of the presence of diseases that might prove dangerous.

PLANT BREEDING.

This work has been pushed as rapidly as possible and is attracting much attention not only throughout this country but also abroad. In accordance with your instructions, an assistant of the Division was directed to attend the International Conference of Plant Breeders held in London during the year. The conference, which was the first of the kind ever held, was designed primarily to bring together the persons interested in this line of work. It was a representative body of men that gathered in London, and the conference, in so far as its regular plan was concerned, was a success. It is gratifying to announce that our representative met with a hearty reception, and everywhere our Government was praised for the advanced steps it has taken in this line of investigation. One particular feature of our work which seemed to attract widespread attention was the practical application of the investigations being made here to agriculture and horticulture as a whole.

During the year further work was carried on with hybrid citrous fruits, the new forms which originated through the work of the Division having been placed where their value can be determined as soon as possible. It is of the highest importance to know as early as practicable the value of the various hybrids that have been obtained and which were referred to in the previous report of the Division, and to this end buds were inserted in bearing trees in a number of places in the South.

In undertaking this work we were confronted with the problem of how to properly control the hybrids so that they could not be sent out without the sanction of the Department, it being recognized that, inasmuch as the work is carried on by the Government, it would not be wise to allow anything that would point to favoritism in the way of distributing them. Satisfactory arrangements have been made in this respect, it is believed; in fact, it would now be difficult to disseminate any of the fruits originated by the Division unless the consent of the Department is obtained.

The seedling pineapples which were obtained as a result of the extensive work in crossing these plants have been kept in the green-houses. They are now large enough to be sent out, and will be placed where their value can be fully determined. The seeds obtained by crossing the oriental hybrid pears with fine varieties of European type were planted and a number of young trees obtained. Buds from these will be inserted in bearing stock with a view of bringing them to fruit as soon as possible. From this work it is hoped to obtain some varieties which will not only produce fine fruit, but which will possess the ability to resist a number of serious diseases to which pears are subject in this country.

Early in the year arrangements were made with the Nebraska Agricultural Experiment Station for some cooperative work in crossing corn. Corn is recognized as one of the most important crops, and it is believed much can be done in improving varieties by crossing. Particular attention has been given to crosses made with a view of obtaining not only more productive varieties, but varieties which will have a higher nutritive value than those now generally grown. There is a wide variation in individual plants of Indian corn, and this indicates the practicability of much improvement by proper selection and crossing. The work has been pushed as rapidly as possible and promises success in a number of directions.

WORK ON THE PACIFIC COAST.

The work on the Pacific coast, which is in charge of an assistant located at Santa Ana, Cal., has been of much the same nature as in previous years. A good deal of the time of the assistant is necessarily taken up in correspondence owing to the extensive territory covered by the investigations. Work has been continued on peach-leaf curl, and on various diseases of lemon, olive, and walnut trees. The walnut crop of southern California is of considerable importance and is taking the place of crops which have hitherto proved unprofitable. The walnut is subject to a number of diseases, and particular attention has been devoted to these during the year. The vine disease, which has been more or less prevalent in southern California for a number of years, has appeared in many new districts and threatens to cause serious losses. However, it has been found that this disease may be kept in check by grafting on certain kinds of roots which are resistant to the disease. This important fact seems now to be pretty well established and extensive blocks of hardy roots are being grown in the infected districts with a view of ultimately grafting the tender varieties upon them.

A few of the seedling vines resulting from crosses of raisin grapes made during the past six years bore fruit this season for the first time. Among those which fruited, there are three new varieties which will certainly prove valuable to the grape industry. These vines show

much greater hardiness of foliage and vine than the raisin grapes now grown—one of the main objects sought in making the crosses. The fruit is also excellent in many essential respects, and a decided improvement of the fruiting qualities of these young vines may be expected as the vines grow older. One of the new varieties produces medium-sized, heavy-shouldered bunches, the berries being much closer set and the bunches more compact than those of the Muscat or Muscatel. Not a berry appears to have been lost from coulure, or blighting of the flowers. Another variety, which also fruited for the first time this season, and which is the offspring of an entirely different cross from the variety first named, inherits the hardy foliage and vigorous habit of growth of the Malaga vine of California. The bunches are a foot in length, and the berries are large and of a light color.

The crossing of raisin grapes has now gone sufficiently far to warrant the statement that time and judicious crossing are all that are necessary to obtain the hardiness of plant and the fruiting qualities required in California, Arizona, and Nevada to withstand the cold spring winds and other climatic conditions causing coulure, and also the attacks of leaf hoppers, so destructive in many raisin-growing sections. The belief is warranted that good raisin varieties, which will be harder in alkaline and other unfavorable soils than the raisin grapes now generally grown, can be produced.

SUBTROPICAL GARDEN.

The subtropical garden, which is located at Miami, Fla., and which has been placed at the disposal of the Department without cost, contains about 6 acres of ground. The plan is to use this garden in making preliminary tests of hybrid fruits obtained in the regular work of the Division and for other practical lines of investigation. It is also used to a considerable extent in testing new plants imported by the Section of Seed and Plant Introduction and about which it is desirable to obtain further knowledge before they are distributed. There are now growing in the garden about 1,150 hybrid citrous trees, many orange, lemon, and lime trees, and also about 100 hybrid guavas and a large number of seedlings grown from seed sent from South America. There is in it, furthermore, a number of pineapple plants and a large number of imported French table grapes, which are being tested with a view of determining their value for the South. On the grounds is a well-built laboratory, which was erected free of cost to the Department and placed at its disposal for use in investigations.

HERBARIUM.

Work in the herbarium has been continued during the year along lines similar to those described in previous reports. For a number of years material has been accumulating which, if properly distributed, would be of considerable value to experiment-station workers and others in illustrating various forms of diseases affecting crops. A special effort has been made during the year to get this material in shape for distribution, and it is now about ready to be sent out. It is hoped to arrange a system of exchange whereby there may be received from experiment-station workers and others specimens which may be properly worked up here and sent out to others interested in this

particular line of work. As a rule, most of the stations are poorly equipped with illustrative material, and if the Department can assist them in this respect it is believed the time will be well spent.

CORRESPONDENCE AND LECTURES.

The correspondence of the Division is constantly increasing, and to properly care for the many inquiries takes up considerable time. By using Farmers' Bulletins, circulars, and other publications, however, we are able to promptly attend to nearly all requests except those where investigations are involved. Often in such cases days, and sometimes weeks, are required to reach satisfactory conclusions as to the causes of diseases affecting the specimens received from correspondents. This work keeps us in touch with the needs of those engaged in agricultural and horticultural pursuits, and therefore we try to give it as much encouragement as our facilities will permit.

During the year farmers' institutes, horticultural societies, and other meetings have called upon the Division a number of times for lectures. These requests have been complied with whenever practicable, and it is believed that it has resulted in mutual benefit to the societies and to the Department. By coming in contact with members of such societies facts are often obtained which could not be gathered in any other way.

THE DIVISION FORCE.

A slight increase in the appropriation of the Division has enabled us to engage two additional assistants. One of these has been detailed to make some preliminary studies of cotton diseases and the other is retained in Washington. In accordance with your suggestions in regard to giving graduates of agricultural colleges opportunities to do post-graduate work, we have secured one scientific aid to assist in laboratory work. Such aids will, we believe, prove of material help in our investigations, and it is hoped that arrangements can be made to secure several others. By getting aids from the colleges little time is lost in preliminary training. Such helpers, however, must be content to work for some time directly under the charge of an advanced assistant in order to obtain the most satisfactory results.

Two assistants were detailed for the greater part of the year to the Section of Seed and Plant Introduction, their services, owing to special training, being considered of value in connection with the collection of certain plants and seeds from different parts of the world. One of these assistants spent several months in Russia collecting cereals, all of which have been sent here for distribution. Another spent most of the year in parts of Europe and Africa, where he collected numerous plants and seeds, as well as many facts, which it is believed will be of value to the country.

THE PARIS EXPOSITION.

In accordance with your instructions and plans made in consultation with your representative and Director of Agriculture on the United States Commission to the Paris Exposition, arrangements have been perfected whereby an exhibit will be prepared which will fully illustrate the work on cereals and cereal production in the United States. This work has been placed in charge of an assistant, who has for some

time been engaged in an investigation of the cereals. According to the general plan, the exhibit will have for its object the setting forth as fully as possible the resources of the United States in the way of cereals. Our principal varieties will be collected in quantity and will be used to illustrate the various purposes to which they are devoted. Particular attention will be given to maize, and a special effort will be made to bring together a collective exhibit which will show to the world our great resources in producing grains not only of excellent quality but also adapted for special purposes. The assistant is now in the field getting the material together.

NEED OF NEW BUILDINGS.

The Division is seriously hampered in its work by lack of sufficient laboratory room, and it is hoped at an early day that better quarters may be secured. A number of the laboratories of the Department are now paying rent for buildings and have other necessary expenses, all of which might be saved by having a proper laboratory building or buildings on the Department grounds. Owing to lack of space in which to put the various assistants, it is often impracticable to carry on the work as it should be done. Moreover, with more room it would be possible to utilize more help in the way of scientific aids, or graduates from agricultural colleges. These aids, with proper room at hand, could be placed in charge of an older assistant and much valuable work might thereby be obtained. We are, furthermore, constantly receiving requests from advanced experiment-station workers for opportunities to carry on certain lines of work here, and it seems desirable to offer every encouragement to such workers. This we have done in all cases where our room and facilities would permit.

WORK PLANNED FOR THE CURRENT YEAR.

It is difficult to anticipate all lines of work, for new questions are constantly arising, and some of these may require the attention of the Division in a number of directions. It is planned to continue the work on nutrition and to inaugurate a number of new lines of work in this field, particularly as regards the study of the nutrition of the cell itself, with a view of obtaining facts on the functions of the plant as a whole. As already pointed out, there are many important questions concerning the breeding of plants which must be studied from the standpoint of nutrition, and these questions will occupy considerable attention during the year.

The work on diseases of timber will be pushed forward as rapidly as possible. There is much complaint from the Pacific coast in regard to these diseases, and it is planned to make some preliminary investigations in that region with a view of undertaking more detailed work at some future time. The conditions on the coast are so different from those in other sections that a special investigation will be necessary in order to arrive at definite conclusions concerning many of the diseases there. Fruit trees are subject to a number of the same diseases as attack timber in the region in question, and it is desirable to look into these maladies at the same time the others are being studied.

The work on shade and forest tree diseases will also be continued, and some investigations will be made looking toward the discovery of the cause and the prevention of many of the injuries to street trees brought on through unfavorable soil conditions.

It will be necessary to continue the work on the little peach disease, as so far the investigations have thrown comparatively little light on the cause of the trouble. Such obscure diseases are difficult to investigate and it may require considerable time to reach any satisfactory conclusions. The work on this disease will consist for the most part in an investigation of all parts of the tree for the purpose of determining the presence or absence of fungi or other organisms, and if organisms are found it will be necessary to determine their relation to the disease. Experiments to determine if the disease can be communicated by budding or in other ways will also be made, and in addition investigations will be started for the purpose of reaching some conclusions as regards the possibility of eradicating it.

It is hoped to inaugurate during the year some practical field experiments with a view of increasing our knowledge as to a satisfactory method of treating pear blight. Considerable evidence is at hand as to the benefit to be derived from cutting out the diseased wood, but much yet remains to be learned as to the best method of doing this and the care with which it will have to be done in particular regions. As yet it is not known how far the organism causing the blight may be carried, and it has not been determined whether the mere removal of all diseased wood in an affected orchard will stop the spread of the disease in that particular orchard. It is very probable that pear blight is often disseminated from nurseries, and it is hoped to inaugurate some experiments with a view of eradicating it in such places.

The soft rot of peach and plum has caused a great deal of injury, and as no satisfactory remedy for the disease has yet been found it is planned to inaugurate some experiments with a view of testing the effect of various fungicides, the value of destroying diseased fruit, and of other preventive measures.

Through the cooperation of the Section of Seed and Plant Introduction, the Division has received from many parts of the world lettuce seed said to be useful for forcing under glass. This seed will be tested during the year with a view of determining the merits of the different varieties in our country, particularly as regards their commercial qualities and ability to resist various diseases which attack lettuce grown in greenhouses. Out of the many varieties obtained only a few have so far proved promising. These will be given further trial, and if found of value the seed will be distributed. In addition to this work the most valuable varieties will be used for crossing—a line of work which so far as known has not been undertaken with lettuce.

The work on crossing tomatoes will be continued, the object being to obtain desirable varieties for forcing under glass. Tomatoes growing in the field have been seriously injured for some time by a number of diseases, and while the causes of these have in many cases been determined, no extensive experiments have been undertaken with a view of preventing them. It is planned to inaugurate some work in this line the coming year, principally with a view of checking a serious disease known as blight, which causes much injury where the crop is grown for canning purposes.

The work on violets, carnations, and other plants will be continued along the same lines as outlined in the last report.

Work on the sea island cotton disease will be pushed forward as rapidly as possible. Field experiments will be made with a view of determining the effects of different fungicides applied to the soil

and of crop rotation, and the possibility of ridding the soil, by methods of cultivation, etc., of the fungus which causes the disease. If opportunity permits, it is hoped to extend the work to upland cotton and to inaugurate an extensive series of investigations on cotton diseases as a whole. In this connection, we have been offered the cooperation of the Alabama Agricultural Experiment Station at Auburn, where there are excellent facilities for work on cotton. It is hoped to take advantage of this offer and to inaugurate a line of work which will be of much scientific as well as practical benefit.

The cooperation with the Division of Soils on tobacco work will be continued and investigations relating to fermentation and curing will be carried on. In addition, considerable attention will be given to the study of the diseases of tobacco, and it is hoped to inaugurate some work in breeding.

The work on yeasts and other ferments will be continued in cooperation with the Section of Seed and Plant Introduction, and the practicability of using the various forms of pure yeasts in the manufacture of wines from apples and other fruits will be looked into. A number of large cider factories have offered to furnish the Department with facilities for testing yeasts on a large scale, and it is hoped we may be able to take advantage of this offer. Some special studies will probably be made of cider yeasts, and these will be distributed in a number of sections with a view of testing their value.

Work on fungicides will be continued, the principal object being to determine the effects of copper on plants and the possibility of discovering some substance which can be used as a substitute for copper.

The work being done with a view of improving spraying apparatus will be continued. In applying fungicides the question now is largely one of economizing labor in application. Machinery plays an important part in the matter, and as yet there are many opportunities for improvement in this direction.

The plant-breeding work will be pushed forward as rapidly as possible. The citrus hybrids, which have been distributed in various parts of the South, will be carefully watched, and their value, so far as hardiness and other qualities are concerned, will be studied. The breeding work on corn now under way in cooperation with the Nebraska experiment station will be continued, and some work of a similar nature on wheat will be inaugurated. Plant breeding is so important that it is deemed desirable to give it a distinctive standing in the Division, and I therefore recommend that the work be placed in charge of one assistant, who will have general supervision of all the investigations in this line. It is also believed advisable to take some steps toward establishing what might be called an international exchange, for the purpose of getting materials in the way of plants and seeds of special value in plant-breeding work. This can probably be done through the cooperation of the Section of Seed and Plant Introduction.

The work on the Pacific coast will be continued, but it is planned to have the assistant who has charge of the investigations come to Washington for several months in order that he may be in a better position to prepare a number of bulletins, the material for which has been accumulating for several years. It is found to be exceedingly desirable to have all assistants engaged in such work as we are doing spend at least a part of the year here, and it is only by adopting this plan that the best results can be obtained. It is proposed to continue

the bacteriological investigation of the olive and walnut diseases, and to set on foot new lines of treatment for the same. It has been learned also that some strains or varieties of walnut are more exempt from the bacterial disease than others, and it is hoped that by judicious selection or by crossing it may be possible to obtain desirable varieties practically free from the trouble named. It is also hoped that time may permit the carrying out of extensive experiments in the treatment of black canker of the apple in Oregon and Washington. This work should be undertaken at an early date if possible. The testing of hardy stocks in relation to their resistance to the California vine disease will be instituted and encouraged as far as practicable. Further crossing of raisin vines is also advisable for the coming spring. It is desirable that the choicer plants of the new varieties now in fruit shall be crossed back upon the Muscat and Muscatel. This would give raisin grapes having three-fourths parentage of the Muscat or Muscatel and one-fourth parentage of the hardy vines heretofore used in the crosses. It is thought that this would tend to improve the size and quality of fruit and still preserve sufficient hardiness of leaf and growth in the new plants to resist the unfavorable climatic conditions and various pests which now affect the Muscat and Muscatel.

There have been many complaints from the citrous-growing region of the Pacific coast in regard to the diseases affecting citrous crops, but the time of the assistant, who is located in southern California, has been so fully taken up with other matters that little attention has been given to citrous diseases as a whole. California is now our principal citrous fruit producing region and there are many important problems there for investigation. It is planned if practicable to send some one into the region during the year with a view of obtaining preliminary facts regarding some of the more important questions involved in the cultivation of such fruits. In this connection, it is also planned to have an assistant visit Porto Rico and possibly Cuba during the year in order to get familiar with some of the more common diseases of plants in these islands with a view of preventing their introduction here. The Division is receiving many inquiries concerning the possibility of cultivating citrous and other subtropical fruits in Porto Rico, and as two assistants of the Division have given special attention to a study of subtropical fruits in the United States, it is believed that a short visit by one of them to Porto Rico would enable him to form conclusions in regard to the possibility of work there which would be of value to the fruit growers of the country.

REPORT OF THE POMOLOGIST.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF POMOLOGY,
Washington, D. C., September 1, 1899.

SIR: I have the honor to transmit herewith a report of the operations of the Division of Pomology for the fiscal year ending June 30, 1899, together with a brief outline of the work of the current year, and a statement of proposed plans and estimates recommended for the fiscal year 1901.

Respectfully,

G. B. BRACKETT,
Pomologist.

Hon. JAMES WILSON, *Secretary.*

WORK OF THE YEAR.

ROUTINE WORK.

As in former years, the routine work which devolves upon this Division has been very heavy. The number of specimens received exceeded those of the previous year.

About 350 fruit descriptions, 200 water-color paintings, 100 photographic negatives, 125 wax models, and over 800 mounted herbarium sheets have been added to the collections.

The regular correspondence has been heavy, and a large correspondence relating to the preparation of horticultural exhibits for the Paris Exposition of 1900 has been conducted without any increase in the clerical force of the Division. Attention to the details of the exposition work has involved some interference with the regular work, but it is believed to be justified in view of the importance of having our rapidly increasing horticultural industries adequately represented at Paris.

DISTRIBUTION OF TREES, SCIONS, CUTTINGS, PLANTS, AND SEEDS.

Through cooperative work with the Section of Seed and Plant Introduction the distribution of promising varieties and species of fruit-bearing trees, plants, and vines has been largely increased. During the year nearly 2,700 lots of such have been placed with about 275 official and private experimenters in the various portions of the country. This distribution embraced nearly 350 varieties, which represented 58 species and 20 recognized hybrids.

Among the most important species in addition to the European grapes were a lime of high repute from the interior of Chile, secured through the activity and interest of Hon. Joseph W. Merriam, consul at

Iquique, and a reputed hardy type of Aguacate or Avocado, "Alligator pear" (*Persea gratissima*), from Coahuila, Mexico. The fruit last named is imported from the West Indies in considerable and increasing quantities, being sold in the Eastern seaboard cities at high prices. For many years there has been a small production of the fruit in Florida, but since the great freeze of 1894-95 it has, in consequence of the susceptibility of the tree to injury by cold, been limited to the extreme southern portion of the east coast and the adjacent keys. In 1893, as noted in the report of the Assistant Pomologist for that year (p. 284), a few seeds of a Mexican type of the species, which is reputed to be more hardy, were secured and distributed, and since that time efforts have been made to obtain a sufficient quantity for a more general distribution. During the year arrangements were made by which, through the courtesy of our consul-general at Monterey, Mexico, Hon. J. K. Pollard, about 2,000 seeds of the desired type were secured in fine condition. These were at once distributed to 86 persons in Florida, Louisiana, Texas, Arizona, and California, a considerable quantity being reserved for planting in the greenhouse here. Numerous reports received concerning these seeds, as well as the large percentage of germination here, indicate that the type may now be considered as sufficiently introduced to be given a thorough test under widely varying conditions of soil and climate in the subtropical portions of the country.

The labor, both clerical and manual, growing out of the handling and distributing of so large a number of plants has been a serious tax upon the time and energy of the employees of the Division.

With the improved equipment in the shape of a storage cellar and packing room provided by the Section of Seed and Plant Introduction it is expected that similar work in future can be done to better advantage.

Careful records are kept of all plants distributed in this way, and our effort is to encourage accurate experimental work on the part of competent fruit growers, from whom valuable data for public information on the adaptability of varieties and species to their localities may be expected in the future.

EXPERIMENTS WITH EUROPEAN GRAPES IN THE SOUTH ATLANTIC STATES.

As noted in the last report, an investigation of the status of the efforts to grow European table grapes in the South Atlantic States was undertaken in cooperation with the Section of Seed and Plant Introduction. In this investigation the Assistant Pomologist visited a number of places in North Carolina, Georgia, and Florida, where efforts of this kind are under way, with a view to determining the advisability of undertaking systematic experiments looking toward the introduction of the culture of the choice table varieties of Europe in that region. As is well known, nearly all the attempts to introduce and maintain these varieties in the past have resulted in failure and death of the vines within a few years. For upward of two centuries the failure was charged to various causes, which may briefly be summarized under the designation "supposed unfavorable soil and climatic conditions." After the discovery, about 1870, that the great destruction of European vines in France was due to *Phylloxera*, it was for a time supposed by entomologists and many grape growers that the failure of the European grape in Eastern America was largely, if not

wholly, due to that cause. More recent investigation has made apparent the fact, however, that fungous diseases affecting leaf and fruit have played an important part in the destruction of vines of this type in the Eastern United States.

The superior flavor and quality of the fruit of the choicer varieties of the European grape, together with the growing demand for fruit products of high quality in our markets, seems to render the effort to introduce them worthy of attention at this time. Agreements have accordingly been made by which two experienced grape growers, one near Southern Pines, N. C., and one near Earleton, Fla., have undertaken the testing of large collections of imported vines under the direction of this Division. Their expenditures for labor, fertilizers, spraying materials, etc., are to be reimbursed to them from the appropriation for pomological investigations. One hundred and nineteen varieties grafted on Phylloxera-resistant American stocks have been planted by these experimenters and 43 varieties of "direct producers," "resistant stocks," etc., have also been so planted. These vines were imported by the Section of Seed and Plant Introduction. Other varieties not obtainable last year will be added during the coming winter, so that a thorough and comprehensive test of all the varieties likely to be useful can be made under conditions where fungous diseases can be investigated and combated by spraying or other defensive methods. Both of the growers referred to have conducted experiments along this line in former years with a fair degree of success, and their locations are considered well adapted to *vitis vinifera* and at the same time typical of large regions in the South Atlantic and Gulf States.

Vines of a few selected varieties grafted on resistant roots were placed with individual growers in favorable locations in Florida, North Carolina, Alabama, Louisiana, and Kansas with a view to determining the adaptability of the several localities to the culture of this species.

EXPERIMENTS IN FRUIT EVAPORATION.

Early in the fiscal year prominent exporters of dried fruits in New York and California entered an emphatic protest in the State Department against the action of certain European Governments, notably those of Switzerland and Germany, in prohibiting entrance of unpeeled dried fruits from the United States. This prohibition was alleged to be for the purpose of guarding against the introduction into those countries of the insect known as San Jose scale on such fruits grown in the United States.

This Division having been asked for an opinion on the probability of the introduction of the scale into foreign countries on dried fruit, a negative reply was made by the Acting Pomologist. It was not believed the scale could survive the high temperature and other vicissitudes which accompany the drying process as commonly practiced. This was considered especially true in the case of evaporated fruits, which are subjected to high temperatures for a considerable time in a closed chamber.

The export trade in dried fruits has become so important in recent years and is growing so rapidly at the present time that any unjust prohibitive action, such as the above, on the part of foreign Governments is likely to have a depressing influence upon our fruit industry. There being no record of experiments covering the points in question, a test of the ability of the scale to endure the drying process was

arranged in cooperation with the Entomologist. In a series of experiments several lots of unpeeled peaches, apples, and pears were carried through the drying process both in evaporator and by sun-drying in the open air. Portions of each lot were dried both with and without exposure to the fumes of sulphur for bleaching. In short, every effort was made to duplicate all the possible conditions under which fruit is dried on the ordinary farm. Careful records of temperatures to which the fruit was subjected in the evaporator were kept. It is gratifying to state that upon subsequent examination by an expert under the direction of the Entomologist no living scale was found upon the fruit. Detailed reports of these experiments were furnished the State Department through the Entomologist for use in sustaining our contention that American sun-dried and evaporated fruit is free from any suspicion of harboring living scale insects or transporting them from State to State or to foreign countries.

ROOT-GRAFTING EXPERIMENTS.

The third year of the nursery period of the second comparative test of methods of root-grafting the apple has been completed. As will be observed from the report of last year, the trees retained for the third year were those remaining after removal and measurement of alternate trees in the spring of 1898 from the rows of those grafted and planted for the test in the spring of 1896. The trees were carefully graded and photographed. Owing to injury by woolly aphis, which interfered somewhat with the experiment during the last year, the three-year-old trees were not planted in sets when removed from the nursery, as were those of the two previous years. The detailed results of the three-year nursery period of the experiment are being prepared for publication.

CARD CATALOGUE.

Work on the descriptive catalogue of fruit varieties has been temporarily interrupted by the serious illness of the special agent in charge of that work, Mr. T. T. Lyon, of Michigan. The catalogue of peaches described in standard pomological works, with the addition of a considerable number of varieties recently introduced, of which original descriptions have been prepared by Mr. Lyon, contains nearly 1,500 cards, of which about 500 are distinct varietal names and about 1,000 recognized synonyms. It is desired to complete this catalogue as soon as possible, as the rapidly increasing number of varieties in cultivation makes its general distribution among fruit growers important.

REVISION OF CATALOGUE OF FRUITS.

As noted in the report of last year, the "Catalogue of fruits recommended for cultivation in the various sections of the United States by the American Pomological Society," which was published in 1897 as Bulletin No. 6 of this Division, has been thoroughly revised by a committee of that society working in cooperation with the Division force. Prof. W. H. Ragan, of Indiana, the chairman of the society committee, who has had the work in charge, has been continued during the year as a special agent of this Division. Much of the actual work of revision has been done in Washington, where the libraries and records, as well as the members of the Division force, could be

consulted, with a view to insuring as far as possible the accuracy of the nomenclature and descriptions of the catalogue.

To secure more definite data in regard to the adaptability of varieties on the Pacific slope, Prof. E. J. Wickson, of the University of California, was last year appointed a special agent to conduct a special investigation on the subject among the growers of that region. His report was made the basis of the portion of the catalogue which relates to the fruit districts of that section.

The catalogue has been considerably enlarged, the revised edition containing descriptions of 1,221 varieties against the 1,107 varieties of the earlier edition.

FIELD INVESTIGATIONS.

In addition to the investigation of the status of the European grape in the South Atlantic States by the Assistant Pomologist, as previously mentioned, an extended preliminary investigation of the condition of the fruit industry in Idaho, eastern Oregon, and eastern Washington was made by the Pomologist during the autumn of 1898.

The fruit industry as a commercial enterprise is comparatively new in the above sections, but the precocity and productiveness of the orchards and vineyards visited and the large size, brilliant color, and excellent keeping and shipping quality of the product render the outlook for the commercial fruit grower very promising. Many varieties of apples and pears which are now grown with much difficulty in the Eastern States, because of their susceptibility to injury by disfiguring fungous diseases, grow to great perfection with only ordinary care in the drier climate of the region mentioned.

The nomenclature and identity of varieties is much confused, however, and in this particular this Division can be of distinct service to the growers through the identification of specimens forwarded to Washington City, though more effectually through field investigation.

DAMAGE TO FRUIT TREES AND VINES BY THE FREEZE OF FEBRUARY, 1899.

The unusually low temperature which prevailed over a large part of the country during the month of February, 1899, worked great and permanent injury to the trees and vines of many important fruit-producing sections. Hundreds, and in some cases hundreds of thousands, of trees of varieties that were supposed to be sufficiently hardy to endure the lowest temperatures that were likely to occur were killed outright or greatly damaged.

A correct understanding and interpretation of the relative effects of this freeze upon varieties differing in hardiness will be of great importance to growers in shaping the commercial fruit districts of the future, as well as in determining what varieties may safely be selected for planting therein. A preliminary investigation of these questions by means of circulars of inquiry mailed to more than 2,000 prominent fruit growers was promptly instituted. The response to these inquiries has been gratifyingly large, and, if followed up by prompt field investigation, is expected to yield results of permanent value to both commercial and scientific pomology.

PREPARATION FOR PARIS EXPOSITION.

The work of planning and preparing for installation the exhibit of horticultural products of the United States for the Paris Exposition

of 1900, which was intrusted to this Division, has occupied a considerable portion of the time of both the Pomologist and the Assistant Pomologist during the last half of the fiscal year. As now outlined and in preparation, the exhibit will be made with a view to showing in attractive form such horticultural products of the United States as are likely to be in demand in Europe and can be obtained in large quantities at the present time or in the near future. Canned, dried, and evaporated fruits and vegetables will be shown in great variety. Such fresh fruits and vegetables as are adapted to the export trade will be shown in large quantity. Of fresh fruits, the apple and the orange will be prominent, and of nuts, the pecan and shagbark.

Opportunity will be afforded for the individual grower to exhibit his products in these lines, so far as possible, in competition for awards.

Large collections of photographs of the commercial features of our horticulture, such as seed farms, nurseries, orchards, vineyards, packing houses, canneries, drying grounds, and evaporators, as well as views of landscape work in home grounds, parks, and cemeteries, are being prepared by exhibitors under our direction.

CURRENT WORK.

In addition to the regular work of the Division, which continues much the same from year to year, special attention will be paid to the continuation and enlargement of the European grape-testing experiments already under way.

A large number of choice, described varieties of table grapes are yet to be secured for testing, and in this the Section of Seed and Plant Introduction will cooperate. In the matter of control of fungous diseases the Division of Vegetable Physiology and Pathology, which has already rendered valuable aid in this direction, will be called upon as occasion may require.

The investigation of the effects of the freeze of February upon varieties will be continued, and it is hoped that much-needed field work in this line can be done in several sections during the year.

The details of gathering, storing, and shipping the large quantity of fruit of the crop of 1899 for exhibition at Paris will require careful attention and a considerable expenditure of time and energy.

PLANS FOR THE ENSUING YEAR.

In outlining work to be undertaken during the next fiscal year, I would again call attention to the importance of providing at an early date for a thorough investigation and report upon the pomological resources of the newly acquired islands of Porto Rico and the Hawaiian group. As fruit culture is likely to become an important item in the rural economy of those islands, it is important that the present status of the industry should be determined in order that light may be thrown on its probable future. The question is important not only to the present inhabitants of those islands, but also to a large number of citizens in the Gulf States, Arizona, and California, whose projected fruit-growing enterprises are hampered by the uncertainty in regard to the lines in which competition may be expected from the pomological products of the islands. I therefore again recommend that a thorough investigation of this subject be provided for under the direction of this Division at the earliest practicable date and that a sufficient increase in appropriation be provided to make its accomplishment possible during the coming fiscal year.

REPORT OF THE SUPERINTENDENT OF EXPERIMENTAL GARDENS AND GROUNDS.

U. S. DEPARTMENT OF AGRICULTURE,
EXPERIMENTAL GARDENS AND GROUNDS,
Washington, D. C., September 12, 1899.

SIR: I have the honor to submit a report of the work in the Experimental Gardens and Grounds for the fiscal year ending June 30, 1899.
Respectfully,

WILLIAM SAUNDERS,
Superintendent.

Hon. JAMES WILSON, *Secretary.*

WORK OF THE YEAR.

DISTRIBUTION OF PLANTS AND BULBS.

There have been distributed during the year the following plants and bulbs:

Plants distributed.

Camphor	5,500	Pineapples	90
English walnuts	150	Privet	1,550
Citrus trifoliata	85	Strawberries	75,000
Figs	960	Tea	180
Grapes	25,000	Miscellaneous plants	834
Guavas	260		
Olives	1,400	Total	111,009

The miscellaneous plants in the above statement consisted of ampe-
lopsiis, avocada pear, bamboo, banana, cinnamon, coffee, kumquat,
loquat, orange, lemon, citrus, pepper, vanilla, willow, carob tree, etc.

Bulbs distributed.

Crocuses	50,000
Hyacinths	25,000
Lillium harrisi	2,000
Narcissus	5,000
Tulips	50,000
Total	132,000

DEMAND FOR CAMPHOR AND TEA PLANTS.

Camphor plants are in much demand, especially for planting as
shade and shelter trees for orange groves, for which purpose it is
well adapted. Plantations for the production of camphor have, in a
few instances, been set out; in these cases from 200 to 400 trees have

been furnished, so that the profits from this industry will ultimately be determined.

An additional interest has lately developed in the growth and production of tea, and applications for plants are frequent. To meet this demand about 10,000 plants have been raised and are now ready for distribution. The condition of soil and best climates for the culture of the tea plant are being better understood, and the question of labor in picking the leaf does not appear so formidable an objection to a profitable industry as has hitherto been supposed.

REPAIRS TO GROUNDS AND HOUSES.

A portion of the concrete roadways, about 5,000 yards, has been thoroughly resurfaced and is now in fine condition. There is still fully as much more surface repairing required to complete the work. Some of the walks have been down over twenty years, and are now greatly in need of attention.

The heating apparatus for the glass structures has been overhauled and repaired where necessary. A new boiler has been procured and put in, replacing the one that leaked.

The work of repairing the greenhouses is being prosecuted as means will allow. This is a somewhat tedious business. The whole of the glass has to be removed, the woodwork renewed where it has decayed, and the glass refitted, after which two coats of paint are put on each house.

The grounds have been kept in good condition, lawns mowed regularly, and walks trimmed. The grass needs a dressing of manure, and some portions require liming.

REPORT OF THE FORESTER.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF FORESTRY,
Washington, D. C., August 31, 1899.

SIR: I have the honor to transmit herewith a report of the work of the Division of Forestry for the fiscal year ending June 30, 1899, together with an outline of the plans for the work of the Division for the coming year.

Respectfully,

GIFFORD PINCHOT,
Forester.

Hon. JAMES WILSON, *Secretary.*

WORK OF THE YEAR.

During the year the work of the Division has been reorganized throughout. The changes entailed, together with the introduction in the United States of practical and paying forestry among lumbermen, on a large scale, the progress of extensive investigations in tree planting, as a preparation for practical work with tree planters, and the very marked manifestation of public cooperation and interest in the work of the Division, especially among lumbermen, are the salient facts of the year. The extent of this cooperation is well indicated by the action of the redwood lumbermen of San Francisco, who have voted to subscribe \$1,000, of which \$550 is already in hand, and have offered free transportation over their roads and free subsistence in their camps to the agents of the Division, for the sake of advancing by a year the time when the Division, otherwise hindered by lack of funds, could begin work on the growth and reproduction of the redwood.

In spite of the increase in its resources made by the last Congress, the Division finds itself wholly unable to cover the field of necessary work which lies before it. Public demands upon it for work of the first importance to the preservation and right use of forests in the United States remain unanswered for lack of means. It is earnestly hoped that the Division may be enabled adequately to take and use during the next fiscal year the unprecedented opportunities created by the rapid awakening of the public mind to the meaning and value of practical forestry.

SUMMARY OF PRINCIPAL RESULTS.

In accordance with the plans set forth in the last annual report, the work of the Division has been very largely field work. Since two weeks after the beginning of the fiscal year there has been no time,

except during the Christmas holidays, when there have not been from one to seven parties in the field. Practical and paying forestry has been successfully introduced on two tracts of a total area of 108,000 acres, and has now entered its second year under greatly improved circumstances, while the preparation of working plans for conservative lumbering has been in progress on more than twice that acreage. Important modifications in practical methods of lumbering have been suggested by the Division and introduced by private owners on a large scale with marked success. Altogether more than 400,000 acres have come under the care or scrutiny of agents of the Division with a view to the practical introduction of improved methods, while the total requests for such work to date have exceeded 1,600,000 acres. The Division is totally unable to meet the public demand upon it in this direction. The necessary preparations have been completed for an offer, similar in its conditions to that which gave rise to these requests, for the assistance of tree planters throughout the treeless regions of the country, and extensive preparatory studies are under way to discover the results of the immense amount of planting already done, very largely with poor results. The circular which makes this offer public has just appeared. Forest fires have been studied both historically among newspapers and other records, and at some length in eight States in the field, and results of importance have been reached and will be published within the year. Studies of the growth and reproduction of five important timber trees have been begun with the idea of determining whether it will pay to hold timber land bearing these trees for a second crop and pay taxes. It is expected that the results for one species at least will be ready for publication during the present year. A series of careful historical studies of lumbering, and of the progress of forestry in the different States and in the country at large, has been undertaken. The forest history of one State is practically completed, and much additional material has been gathered. A plan for systematic contributions to the knowledge of North American forests has been devised, and has already yielded very valuable results. The Division has been thoroughly equipped with instruments for field work. A system for a photographic forest description of the United States has been worked out, and the collection is well under way. The mailing list has been carefully revised and increased from 1,200 to 6,000 names, including about 2,000 newspapers, while the personnel of the Division at its highest was more than five times the total membership at the beginning of the last fiscal year.

Throughout the year the Division has been in close, and to it most fruitful, cooperation with the forest work of the United States Geological Survey.

ORGANIZATION.

In view of the radical changes which have been made, a word on the organization of the Division is required. At present all its work is assigned to four sections, each with a man of special knowledge and qualifications at its head. These are the Section of Working Plans (in charge of Henry S. Graves, Superintendent of Working Plans), to which all practical work in the woods is assigned; that of Economic Tree Planting (in charge of James W. Toumey, Superintendent of Tree Planting), whose function is sufficiently indicated by its name; that of Special Investigations (in charge of George B. Sudworth,

Dendrologist), dealing with the habits and characteristics of trees which affect their use in practical forestry, and that of Office Work (in charge of Otto J. J. Luebker, Head Clerk). Because of the absence of the Dendrologist in the field for several months on work of importance in connection with the United States Geological Survey, the Section of Special Investigations has been for the year in the immediate charge of the Forester. The technical assistants, under the supervision of the heads of sections, are of various grades, of which two only need be mentioned here.

COLLABORATORS.

The first grade, that of collaborator, is filled by experts of established reputation in forestry, lumbering, or tree planting, not otherwise connected with the Division, who have knowledge of special value to it. They are not residents of Washington, but scattered throughout the country, and their function is to prepare and forward for publication treatises on subjects previously agreed upon. The result of the association of these gentlemen with the Division, of whom there are now eight, will be the preparation of authoritative statements of great value at a very moderate cost. The pay of a collaborator is \$300 per annum.

STUDENT ASSISTANTS.

The grade of student assistant was created for two reasons: First, to provide trained men for the future needs of the Division, and second, to supply it at once with assistants of high intelligence at small cost. The great majority of student assistants are college or university men. Only those who have declared their desire to adopt forestry as their profession are received, and among these a rigid selection is possible because the demand for places very largely exceeds the number of positions. In the field, the student assistants work under the supervision of trained foresters, with results of marked value to the Division, chiefly in the preparation of working plans and the study of commercial trees. Living usually at lumber camps, they keep the same hours as the men, and often, on the testimony of the latter, do the harder work. The practical experience they gain is in no sense intended to replace thorough training at a forest school. The pay of a student assistant is \$25 per month.

About twenty-eight student assistants have been on the rolls of the Division since July 1.

SALARIES.

The expenditure for salaries of all kinds during the year reached 62.2 per cent of the total appropriation. This proportion would have been somewhat reduced had the field expenses borne by private owners been paid by the Division. (See under "Working plans," below.) A larger proportionate amount of field work during the present year will, it is hoped, tend to lower the present figure, which, under the circumstances, is not unsatisfactory.

SECTION OF WORKING PLANS.

WORKING PLANS.

Last October, through the medium of Circular No. 21, an offer of practical advice and assistance was made to farmers, lumbermen, and

others in handling their forest lands, with a view to bring about the substitution of conservative for destructive methods. The offer provided for the preparation of working plans with full directions for work, as well as for practical assistance on the ground, without cost to the owner of wood lots, but in the case of larger tracts at the cost to the owner of traveling expenses and subsistence, together with the necessary helpers, for the agents of the Division while in the field.

In response to the circular there were received during the year applications from 123 owners in thirty-five States for assistance in the management of 1,513,592 acres. Of these applications, 48 were for large tracts covering together 1,506,215 acres, and the remainder were for farm wood lots. Personal attention on the ground was given to 41 tracts, covering about 400,000 acres in nineteen States. On the majority of these tracts it was found possible for the owners to carry out the working plans without personal assistance, but on 15 of them the participation of the Division is required for the execution of the plans. On two of the latter, with a joint area of 108,000 acres, the working plans were put in execution early in the year, and at the present writing the first year's work has been successfully completed, and the second year's work is well advanced under very favorable conditions. A calculation based on exact measurements of the amount of lumber wasted by the prevailing practice of cutting high spruce stumps in the Adirondacks led to a decided change for the better on the tracts just mentioned, and at the same time a marked reduction in the amount of young spruce cut for road building was brought about. These are influential changes. A detailed account of the work on these two tracts, entitled "Practical forestry in the Adirondacks," by Henry S. Graves, Superintendent of Working Plans, is now in press.

The total expense during the year under the ledger head "Working plans" was \$4,133.35, or 14.5 per cent of the total appropriation. The expenditures of private owners, under the terms of Circular 21, amounted to 8 per cent of the same, or \$2,239.23.

The work between July 1 and August 31 of the present year consisted in the preparation of working plans upon two large tracts in the Adirondacks, comprising an area of about 100,000 acres, in making preliminary examinations of seven additional tracts, and in the continuation of the work already in hand. In connection with the first, a special study was made of the growth and production of spruce on the eastern side of the Adirondacks and of birch and maple on the western slope. Additional application has been made for about 100,000 acres.

STUDIES OF COMMERCIAL TREES.

Studies have been in progress during the year on five species of commercially valuable trees to determine their rate of growth and to ascertain their special qualities in forestry. The more important of these studies deal with the loblolly pine in North Carolina, a tree of the first economic importance, and the red fir in Washington, also called Douglas fir, yellow fir, Oregon pine, etc., one of the most valuable and widely distributed trees of the world. These studies have met with the most cordial reception from lumbermen, and have led to the expression of much friendly feeling and the rendering of much practical assistance, in addition to the contribution of the redwood men of San Francisco, already mentioned.

Thirteen men in all have been employed on this work at different times during the year, and the total expense has been \$4,221.35, or 14.8 per cent of the total appropriation.

From July 1 to August 31 the work outlined above has continued without notable change except the addition of ten men, chiefly student assistants.

INSTRUMENTS.

The total lack of field instruments at the beginning of the year made necessary a very large expenditure for that account. At present the Division is well equipped with the indispensable material for effective field work, but at a cost for the year of \$1,766.48, or 6.2 per cent of the total appropriation.

SECTION OF ECONOMIC TREE PLANTING.

In accordance with the recommendation made in the last annual report, the planting of experimental plats in cooperation with State agricultural experiment stations has been entirely discontinued, and arrangements have been made whereby the stations have taken over the plantations, together with the responsibility for them. This step was taken after a thorough study of the old plan, after careful examination on the ground of the plantations at nine of the eleven stations, and with the acquiescence of the authorities of every station. After considerable difficulty this matter has been entirely disposed of, with the exception of delayed settlements with two of the nurserymen who were under contract to raise seedlings for the use of the cooperative experiments. It has been replaced by two lines of activity: One, a careful study of the results of planting already done, in which all the species used in the cooperative plantations are represented, and from which practically all the results to be expected from them after many years may be obtained without delay and far more cheaply; and the other, the giving of practical advice and assistance to tree planters under the terms of an offer similar to that made to forest owners in Circular 21. The work involved in disposing of the cooperative experiments has delayed the publication of this offer (in Circular No. 22, recently issued) until the present fiscal year, but the preliminary work was accomplished before the year began.

Close relations have been established, through correspondence and by personal contact, between the Division and five of the most competent men in the treeless regions, and these gentlemen are now preparing, from the results of their past experience, supplemented where necessary by further investigations, reports on subjects of direct interest to the tree planter. It is believed that these reports will be of capital importance to this branch of the Division's work.

The expenditure of this section for the year was \$4,111.98, or 14.5 per cent of the total appropriation. A very considerable part of this sum was expended under contracts connected with the cooperative plan now laid aside.

From July 1 to August 31, 1899, the studies and the preparatory work of the section have been continued, and the offer above referred to has been made known through the publication of Circular 22.

SECTION OF SPECIAL INVESTIGATIONS.

FOREST FIRES.

Field work on forest fires was carried on in Wisconsin through the courtesy of the geological survey of that State, in Colorado (two parties) and Montana through cooperation with the United States Geological Survey, and by members of the Division in the States of Washington, Florida, Georgia, and New York.

A historical study of forest fires, with the purpose of ascertaining the amount of damage and the true place of fires in the economy of the forest, was begun in the latter part of July. The number of records obtained was 4,327, beginning in the year 1754. One thousand one hundred and fifty-five volumes of newspapers have been examined, and in addition about 500 other volumes. The available files of the best newspapers of seventeen States have been searched. Besides that made in the Library of Congress, extensive research has been carried on in New York, Boston, and Madison, Wis. About 1,200 records have been briefed and transferred to a classified card index.

The expenditure under the ledger head of "Forest fires" was \$4,306.09, or 15.1 per cent of the total appropriation.

During July and August, 1899, about 1,000 additional records have been obtained, so that the total is now considerably more than 5,000. Field work was in progress in four States. A special study of reforestation on burnt land is in progress in the Medicine Bow Mountains of Colorado, and promises most interesting results.

STUDIES OF NORTH AMERICAN FORESTS.

A series of studies by experts with special knowledge of definite localities has been undertaken during the year, and it is expected that three of them will be ready for the printer during the coming winter. Part of this work is in cooperation with the United States Geological Survey. From the character of the contributors to this series results of permanent value are confidently expected.

STUDIES OF FOREST HISTORY.

Historical studies of progress in forestry were begun for New Jersey, Massachusetts, and other States, and practically completed for New York.

During July and August, 1899, much material was collected for a general account of the progress of forestry in the United States, and of the practical application of conservative forest treatment in this country until now, which is much more frequent than is usually supposed.

PHOTOGRAPHIC FOREST DESCRIPTION OF THE UNITED STATES.

Noteworthy progress has been made during the year, although far less than is hoped for in the present twelve months. The collection is now in a position to grow rapidly and systematically. It has absorbed 1.4 per cent of the total appropriation, or about the same amount as sundries and contingent expenses. Altogether the Section of Special Investigations has consumed 21 per cent of the total appropriation.

SECTION OF OFFICE WORK.

ROUTINE.

In spite of the very drastic reorganization to which it was subjected, and in which much time and energy was consumed, the Section of Office Work has done excellent service during the year, and is now in a condition of high efficiency. New systems of filing have been introduced, a carefully selected mailing list of 6,000 names, including about 2,000 newspapers, has been prepared from a nucleus of 1,200, and a rapidly increasing correspondence has been systematically handled.

PUBLICATIONS.

The publications for the fiscal year have not been numerous because of the reorganization of the divisional work, but the material accumulated during the year will furnish a far larger number in the ensuing twelve months.

TREE BOTANY.

The botanical work formerly carried on by the Division was abandoned at the beginning of the year, and its botanical collections have been turned over to the National Herbarium and the Division of Botany.

WORK FOR THE ENSUING YEAR.

No further readjustment of the work of the Division, and but slight addition to its personnel, will be required during the ensuing year. All the lines of work it is proposed to follow during 1899-1900, except the watershed investigation, were either fully organized or well begun in 1898-99.

WORKING PLANS.

Of the total amount of land submitted to the Division for working plans, about 1,200,000 acres have not been examined. During the ensuing year these tracts will be considered as fast as the force of the Division will permit, and working plans will be made for a selected number. One or more of the working plans already in preparation will be printed.

STUDIES OF COMMERCIAL TREES.

In addition to the completion of the work on the loblolly pine and the spruce of the eastern Adirondacks and the continuation of work on the other trees already undertaken, the intention is to begin the study of the coast redwood in California without delay, and later, if money enough can be saved for that purpose, to take up the white oak and the hickories.

ECONOMIC TREE PLANTING.

In addition to the studies now under way, the work for the present year will consist largely, first, in giving practical assistance to tree planters in the selection of the right trees to plant and in planting them rightly, and, second, in an attempt to determine in definite

figures the true effect of bare and wooded or brush-covered slopes on the run-off of streams. This problem is a difficult one, but it is believed that facts of real value may be brought to light. The vastness of the interests affected by the solution will justify the most persistent and careful work.

SPECIAL INVESTIGATIONS.

The field work and other lines of effort already begun are to be continued. Further results from the studies of North American forests and of forest history are expected during the year.

The extension of the historical work on forest fires to States not yet reached is urgently required, and field work will be carried on in the States where it is already in progress, and in special localities in the Southeastern United States. The collection of photographs will receive much attention during the winter.

REPORT OF THE CHIEF OF THE DIVISION OF SOILS.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF SOILS,
Washington, D. C., August 25, 1899.

SIR: I have the honor to transmit herewith a report upon the work of the Division of Soils for the fiscal year ending June 30, 1899.

Respectfully,

MILTON WHITNEY,
Chief.

Hon. JAMES WILSON, *Secretary.*

WORK OF THE YEAR.

PRINCIPAL LINES OF WORK.

The work of the year has been a continuation and an extension of the work of previous years. It consists of the investigation of alkali soils and irrigation, soil mapping, physical investigations, instruments and methods, soil moisture records and climatology, chemical investigations, tobacco investigations, work for the Paris Exposition, and the clerical work incident to the field and laboratory investigations, together with the ordinary correspondence of the Division.

ALKALI SOILS AND IRRIGATION.

The most interesting and probably the most important economic work which the Division of Soils has undertaken is the investigation of the alkali soils of the irrigated districts in the West. Nearly all of the older irrigated districts are suffering more or less seriously from alkali and from the rise of seepage waters in the soils. The subject is of the utmost importance and the work of the Division has attracted very wide and favorable notice. Bulletin No. 14, on the alkali soils of the Yellowstone Valley, was published during the early part of the fiscal year, and Farmers' Bulletin No. 88, based upon this, was published immediately afterwards to meet the great demand for information on this subject. This latter bulletin was distributed to about 10,000 names sent in by the various railroads in the West, besides the usual large distribution of this class of literature.

It is gratifying to report that the methods and equipment of the field parties have been perfected and greatly simplified during the year, the parties now being thoroughly well equipped for the investigation and mapping of extensive areas of alkali lands.

The electrolytic bridge, used for determining the soluble salt content of soils, has been simplified until it is now in a thoroughly satisfactory form, adapted to accurate and rapid field work. The instrument is

smaller than the one first used by the Division, weighs less, and has a direct reading scale, giving the resistance of the soil in ohms. It is now upon the market and several instruments have been purchased by experiment stations and private individuals.

This instrument gives only the total soluble salt content in terms of some standard, the standard usually being a mixture of the salts representing the actual composition of the soil as determined by chemical analyses. It was very troublesome to depend upon the laboratory for this data, and quite annoying to have to wait for the results of the chemical analyses before knowing the exact composition of the mixed salts in any particular district. A very convenient, rapid, and accurate volumetric method was therefore devised in the Division in cooperation with the Division of Chemistry for determining in the field the relative amount of chlorides, sulphates, and carbonates which form the bulk of the salts in the alkali lands. The composition of the alkali can now, therefore, be rapidly determined in the field, and this has added very materially to the efficiency of the field parties.

Quite recently it was found, in working in the black alkali districts, that a considerable part of the sodium carbonate was in the form of bicarbonate, which so far as we know is comparatively harmless to crops. The methods used for determining the carbonate of soda also took in this form of bicarbonate; therefore the results were vitiated to the extent that all of the carbonate found was not equally harmful. A method was therefore devised in which the sodium carbonate is neutralized by the acid sodium or potassium sulphate, using an indicator to tell where the alkali soil extract becomes exactly neutral. The acid potassium sulphate does not react with sodium bicarbonate; so the real alkalinity of the soil is thus rapidly and quickly determined in the field. This method is exceedingly sensitive, detecting with certainty 0.002 per cent of sodium carbonate, while the limit for most plants is 0.2 per cent.

The results of the field work at Billings, Mont., published in Bulletin No. 14 of this Division, set forth very clearly and logically the source of the soluble salts of this locality in the rocks from which the soils were derived. They show also the cause of the accumulation or rise of alkali and seepage waters in the arable soils around Billings, the conditions tending to bring about these evil consequences, and the methods of underdrainage which should be used in the prevention of similar injury to valuable lands and in the reclamation of lands already injured by seepage water and by alkali. Detailed maps were prepared of a small area, showing for each foot in depth down to a total depth of 10 feet the distribution of the alkali and seepage waters. This is a most important basis for the installation of drainage works, as it shows the natural lines of drainage in the soil along which the open drains or tile-drains should be run.

During the following winter active preparations were made to continue and extend these investigations during the present season into other districts, and in March a field party, thoroughly equipped for rapid and accurate field work, was sent out to survey the irrigated districts of the Pecos Valley, New Mexico. Data have been collected for the accurate mapping of the soils and alkali conditions over approximately 100 square miles, and a reconnaissance was made of a very much larger area. The data collected in this work will be arranged for publication as soon as the material can be worked over and the maps prepared.

The principal districts examined covered an area of about 25 square miles at Roswell, N. Mex., and about 75 square miles at Eddy (Carlsbad), N. Mex., while more or less detailed work was done at Hagerman, N. Mex., and at Barstow, Tex.

At Roswell the principal source of the water supply is good. It is obtained from the North and South Spring rivers, fed by very large and deep-seated springs in the artesian basin of the Honda River. These waters carry on the average about 76 parts of soluble material per 100,000 parts of water. The Berendo River, also used to some extent in this district, rises in gypsum lands and carries very much larger quantities of soluble matter—on an average about 250 parts per 100,000—and needs to be used very sparingly and with caution.

The waste waters from these streams and all drainage waters from the district around Roswell are caught and turned into the Northern Canal, which irrigates the land around Hagerman. At this point the water carries about 200 parts of soluble matter per 100,000. Below this the Pecos River, which collects the surplus water from these two districts, is dammed a few miles above Eddy to supply the Southern Canal system, which irrigates a large district around Eddy. This water contains on an average about 310 parts of soluble matter per 100,000, and in dry seasons the amount goes up to over 500 parts, and approaches the limit of endurance of most cultivated plants. At Barstow, about 80 miles below Eddy, the amount of soluble matter increases considerably, until, even under normal conditions, it is near the limit of endurance for most crops.

Within the districts named there are large irregular areas of gypsum soil, which have a remarkable power of allowing seepage waters to percolate freely and to a very long distance. Even the normal seepage from the canals through this soil has supplied such an excess of water as to have ruined large areas upon which no irrigation had been practiced. At one point below Eddy the canal loses 17 per cent of its volume in a distance of about $1\frac{1}{4}$ miles.

These conditions—the increase of the salt content of the waters in going south and the occurrence of these gypsum soils—make the treatment of the alkali lands and protection from injury quite different in the several districts, so that the problem is not altogether a simple one.

At Roswell the soil originally contained a large amount of alkali at a depth of from 2 to 6 feet, with very little showing on the surface. In the alkali flats and in lands which have been less injured by seepage waters and alkali the salts are found mainly in the upper soil, or within 3 feet of the surface. The water supply is excellent, and simple drainage, with occasional flooding, would be sufficient to remove the source of trouble and to reclaim even the worst lands. Due consideration must be given, however, to the location of the gypsum soils and to the line of natural drainage, as open drains are quite inefficient in such soils when run across the line of natural drainage.

At Eddy in such soils the conditions are much more complex, as the soil is naturally free from alkali, while the water contains a large amount. Here the canals must be protected by cementing or other efficient means, where they pass through the gypsum soils, while underdrainage, frequent floodings, and a large amount of water must be used to wash out the salts left by the evaporation of the water used in the ordinary irrigation processes.

These statements show the complexity of the subject, and yet it is gratifying to state that in none of the districts investigated by this

Division have the difficulties appeared insurmountable when good water is available.

In the work at Roswell the Division had the cooperation of the New Mexico experiment station, as Prof. J. D. Tinsley, of that station, assisted in the work.

For the fiscal year ending June 30, 1900, arrangements have been made to cooperate with the Utah experiment station in the investigation and mapping of an area of about 200 square miles in the immediate vicinity of Salt Lake City, in the area watered by the Jordan River. Cooperation has also been decided upon with the Arizona experiment station, and it is proposed to spend about three months in mapping the alkali soils in certain districts of that Territory. Later it is proposed to have a party in southern California cooperating with the California experiment station in studying the very important and complex problems presented in that region. It is planned to have two field parties out during the greater part of the year. In addition to the work just mentioned, a reconnoissance will be made in Colorado and Utah, and probably another large area will be studied in detail, but the locality has not yet been decided upon.

To show something of the economic importance of the alkali problem, Mr. Gardner reports that in the area around Salt Lake City, on what was formerly the most fertile land of the valley, the injury from seepage waters and alkali has become so great that lands which were formerly valued at from \$50 to \$75 per acre are now lying out as barren wastes, many of them of no value and some of them having a nominal value of from \$5 to \$10 per acre for pasture. These lands could, without question, be reclaimed by thorough underdrainage, at a cost varying from \$10 to \$20 per acre, depending upon the character of the soil and the location, provided large areas were reclaimed. As the lands thus reclaimed would approximate their original value, there is indicated a profit of from \$30 to \$50 per acre, at a very conservative estimate upon the original value of the land. I know of few more profitable lines in agriculture than the reclamation of many alkali areas which the Division of Soils has examined.

This injury has been so sudden and so widespread that the property value of whole townships may be almost entirely destroyed within the course of two or three years.

In many cases the proper treatment for these lands, both to prevent the rise of alkali and seepage waters and to reclaim the damaged lands, has been pointed out so logically and strongly that the arguments are almost irresistible, but so far very little attention has been paid to the advice so given and very few attempts have been made to use the information thus disseminated. As a rule, the person whose land has been ruined has not the money to invest in improvements, while those whose lands have not yet been affected can not see the necessity of protecting themselves, and almost before they realize their condition their crops are destroyed and the value of their lands has shrunk to some nominal figure.

In view of these facts and in order to impress strongly upon the minds of the people the comparative ease and certainty of reclaiming the lands with proper methods, I would strongly recommend that Congress be asked to increase the appropriation for this Division by an amount of \$10,000, to be used for demonstrating the practical value of underdrainage and of other methods for the reclamation of alkali lands. In view also of the economic importance of the subject and the widespread damage which has already been sustained, this

would be a small amount to use in an object lesson which, in my opinion, would be of the greatest benefit to the irrigation farmers.

The reports and maps issued by the Division are well enough in their way, but they do not attract the attention and do not have the weight of a practical demonstration of the efficiency of the methods recommended for the protection and reclamation of these lands.

If the money should be appropriated, I would plan, with your permission, to take up a tract of 25 or 50 acres in several of the typical alkali districts, where the different forms of alkali salts predominate and where different conditions of soil and water prevail.

The Division should secure the services of an expert drainage engineer, as we now have of a tobacco expert, and through his advice and assistance the conclusions and recommendations of the Division of Soils should be applied to the reclamation of these lands in a thoroughly practical way. It is my opinion that this work should be distributed over four or five of the arid States, and that it should be done, so far as possible, in cooperation with the experiment stations and with the State authorities. After the practical and economic results are established the Division of Soils should withdraw from said cooperation. This recommendation, therefore, does not imply the establishment of permanent stations, but of certain investigations which should extend over periods of from three to five years.

SOIL MAPPING.

In my last report I called attention to the fact that the investigations of the Division had progressed so that we were now in a position to equip field parties for the detailed mapping of soils. During the present year detailed work has been carried on along these lines in several localities. A definite agreement has been entered into with the Maryland geological survey, cooperating with the Maryland experiment station, in which this Division has undertaken to map the soils of Maryland. The Maryland geological survey shares the expense of the field work. It is proposed to issue a series of soil maps with sufficient explanatory text to make the work intelligible, while the Maryland geological survey will publish the same material with reference more particularly to local interests in the economic studies of the State.

In pursuance of this plan, about 250 square miles were mapped in Washington County, Md., including the larger portion of the well-known Cumberland Valley, and about 250 square miles in Cecil County. Manuscript maps have been prepared showing very clearly, with different colors, the area and distribution of the different soil formations of the several localities. It is proposed to push this work vigorously during the coming year.

An arrangement has also been entered into with the Louisiana experiment station, in which this Division has agreed to map the soils of Louisiana and be responsible for the preparation of reports, the material to be available both for the Department of Agriculture and for the Louisiana station. The station will in this case also share the expenses of the field work. To carry out these lines of work it is proposed to have two field parties out during the coming year.

Arrangements are also pending with one of the other State geological surveys for the mapping of the soils of the State in connection with the economic work of the survey.

Authority was granted by Congress, in the last appropriation bill, for the Division to map the soils of the principal tobacco districts of

the United States. In pursuance of this work, a field party was organized and started on the first of July, 1899, to map the soils of the Connecticut Valley. This district can probably be completed during the present field season, and another district, not yet decided upon, will be taken up next spring. These tobacco-soil investigations are being supplemented by other lines of research as to the character of the tobacco grown upon the different soils, which will be reported in another place.

I look with great favor upon the cooperation which has been established between this Division and several experiment stations and State geological surveys, for it gives promise of being of mutual benefit to this Division and to the public. After years of hard work and careful research, the Division has devised methods and has trained men for field investigations. We are thoroughly prepared for field work, so far as the means at our disposal will permit. The experiment stations and the State geological surveys are not familiar with the methods of field soil work, and there are no men available except in this Division for such lines of work in this country. In this cooperation the State organizations get the benefit of our training and experience, while the Division gets the very important benefit of increased funds for field expenses and the association with local institutions thoroughly familiar with local conditions and resources. Furthermore, the results of the investigations are presented in connection with other economic lines of work, and are distributed where they can do the greatest amount of local good. The State organizations are thus relieved of responsibility in the direction of the work, while the Division is enabled to cover a far larger area of country than would otherwise be possible.

PHYSICAL INVESTIGATIONS.

While the field parties are doing the most elaborate and conspicuous work for the Division, the success of their investigations depends in a large part upon the methods and principles worked out in the laboratories of the Division. To a large extent the field parties apply the results obtained in the laboratory as a basis for the classification of soils and description of the soil conditions. To support the field parties in their work and to help them interpret the results and observations they make upon economic problems, important physical lines of research have been carried out in the laboratories of the Division.

Investigations have been made during the past year as to the influence of the texture and chemical composition of the soil upon the evaporation and seepage waters; particular attention has been given to the influence of the presence of the so-called alkali salts upon the evaporation from a water surface, in which it has been shown very conclusively that the remarkable effect of these salts in conserving the moisture in soils, which is a very noticeable thing in the arid regions, is due to the formation of a thin film or crust of salt, often imperceptible to the eye, which forms on the surface of the ground as the first effect of evaporation. Where the surface of the ground is kept constantly stirred the presence of the salts seems to have little effect upon the evaporation.

The absorption of salts by soil grains and the chemical changes taking place in the soluble salt content of soils has also been studied in some detail to throw light upon the effect of leaching, upon the

drainage, flooding, and the use of chemical substances to reclaim alkali soils, and upon the effect of fertilizers in general.

Another important but difficult problem has continued to receive attention, namely, the study of the physical properties of loam and clay with reference to their structure, plasticity, flocculation, and packing, the extreme contraction of certain soils on drying, and the formation of hardpan, which is a very important problem in many sections of the country. Many complaints have been received by the Division, especially in the past season, of the formation of hardpan just below the depth of plowing in the irrigated lands of portions of southern California, which has proved very troublesome and has done a considerable amount of damage.

These subjects are exceedingly intricate and difficult to work out, but the vast importance of the economic problems depending upon these physical properties of soils justify a prolonged and searching inquiry into the matter.

INSTRUMENTS AND METHODS.

The electrical instruments devised by this Division for soil investigations have been gradually perfected, so that it is believed there is little possibility now of improving their form or of reducing their cost.

The instruments were devised to determine the moisture content of arable soils, to determine the temperature of the soil, and to determine the soluble salt content of soils. The first instrument used by the Division had several switches, adapting the same instrument for use for all of these purposes. As a matter of convenience, however, three instruments are now used, thus simplifying and greatly reducing the size and weight and lessening the cost of each. They are being made upon a commercial basis by one of the large New York electrical companies and can be purchased in the open market. This relieves the Division of what was becoming the onerous duty of issuing instruments to various experiment stations and individuals in a cooperation which was of comparatively small value to the Division.

The instruments each have a direct reading scale, so that no calculations or reductions are needed except in the electrolytic bridge used for salt determinations. The soil hygrometer indicates the relative amount of water in the field at any depth occupied by the electrodes, in terms of some known amount which is taken as the normal or standard. This is usually the optimum amount required for vegetation upon that particular soil, as determined from experience or as arbitrarily selected.

The electrical thermometer gives readings directly in degrees of the Fahrenheit or Centigrade scale, according to the calibration, and has the advantage that the temperature coil can be deposited in places difficult of access and connected by wires to the measuring instrument. This instrument has a number of commercial uses besides its use in soil investigations, and is being introduced into various commercial lines.

One valuable use of the electrolytic bridge for soluble salt determinations, which has not before been pointed out, is for recording the purity of the water supply for irrigation purposes. The total solids, which is a very good indication of the value of water for irrigation purposes, can be quickly determined by the use of this instrument, and it is therefore well adapted for use in general prospecting for water. Furthermore, where the salt content of water is high and

approaches the limit of profitable use, an electrode can be suspended in a canal, flume, river, or reservoir from which daily readings can be taken to determine the fluctuations in salt content due to evaporation, storm waters, or other causes. This is particularly important under certain circumstances in deciding which waters should be collected in the reservoir and which rejected on account of the salt content and when unusual precautions should be taken in applying irrigation waters to the land. In certain localities such daily observations as these would be of inestimable value to the water companies and to their patrons. Where the water is of good quality this would be of much less importance.

The three forms of electrical instruments have been described by Mr. Briggs in detail in Bulletin No. 15 of this Division.

SOIL MOISTURE RECORDS AND CLIMATOLOGY.

The extensive series of soil moisture records which have been carried on by the Division of Soils for a number of years were given up at the close of the last season. Among the valuable features brought out by these moisture tests were the optimum amount of water for normal plant development of a number of important types of soils under prevailing climatic conditions, the extent and rapidity with which the rainfall passes down into the soil or is lost by evaporation for a number of these soils, and the lines of drought and of excess of moisture for the various soils and for several crops. The investigations have also thrown an important light upon the possible extent of the control of moisture conditions through methods of cultivation and of fertilization. The possibility of such control appears to be much less than was formerly supposed.

In my previous reports I have called attention to the relation of the soil moisture, the temperature, relative humidity, and wind velocity as factors in the growth of crops. It was stated that an approximate numerical relation had been worked out between soil moisture and the temperature, humidity, and velocity of the air. Several consultations were held with the chief of the Weather Bureau with reference to the extension of these investigations in climatology with soil moisture as a principal factor. Owing to the great development of the work of the Division, however, in field investigations this work has been laid aside for the present. The subject, although of the greatest importance to agriculture, is admitted to be very complex, and it would take a long while to establish the normal conditions and to work out the actual relations in the several factors which have been only approximately determined by the work already done. In view of the important developments along economic lines of the work of the Division of Soils this climatological work has necessarily been held in abeyance during the greater part of this year, and there seems little possibility of taking it up during the coming year, so that the moisture observations have been given up for the present. These moisture observations were throwing a very important light upon various agricultural problems connected with the relation of soils to water and to plant growth, and to the effect of fertilizers and cultivation upon the moisture content of soils, and it is extremely desirable that the subject be further investigated in the near future; but this can not be economically done without a considerable enlargement of the work to include a study of the other features of plant growth. The observations should not be resumed, therefore, until this extension of plans can be provided for either in the Weather Bureau or in the Division of Soils.

CHEMICAL INVESTIGATIONS.

With the cooperation of the Division of Chemistry an important line of research has been undertaken in the study of the chemical composition of important types of soil and in the relative solubility of the soil in solvents, to throw light particularly upon the mineral constituents and upon the relative availability of the mineral constituents for plant foods.

This work is based upon what is probably the most extensive and comprehensive collection of soil samples which has ever been made. The soil collection of the Division amounts to over 4,000 samples, 252 samples having been collected during the present season from 22 States and foreign countries. These samples have been collected with great care to represent important and marked types of soil, and we have full notes of their origin, products, and agricultural value. They have been grouped under appropriate classes, catalogued, and arranged in the most convenient manner for thorough investigation.

In addition to this collection, the Division of Soils, through its various expeditions, has collected a great amount of information regarding the physical and chemical character of the large areas represented by these samples, and these notes give valuable data to base these chemical investigations upon. The material and observations have been accumulating for years with this object in view of eventually providing the best possible conditions for chemical investigations of certain important economic problems that have not heretofore been clearly understood.

Several chemical methods have been devised for use in field investigations and in the mapping of soils, and several minor problems encountered in the field work have been investigated during the year.

TOBACCO INVESTIGATIONS.

In the last appropriation bill Congress authorized a very comprehensive line of tobacco investigations to supplement the work of this Division in the investigations of the soils of the principal tobacco districts. Although the money was not available until the first of July, 1899, considerable preliminary work was done during the past year and some important results have been attained.

Through the cooperation of the Division of Vegetable Physiology and Pathology, Dr. Oscar Loew was detailed to make some chemico-physiological investigations. In December he went to Florida in company with Mr. Means, of this Division, and records were obtained of the conditions in the fermentation of Florida tobacco. A report has been published showing the moisture content of the tobacco and the temperature of the fermenting piles, which will be a valuable guide in the manipulation of tobacco for persons who have not had practical experience in this work.

Dr. Loew's investigations were published in Report No. 59, entitled, "Curing of cigar-leaf tobacco in Florida." Dr. Loew found that the fermentation, in which the flavor and aroma of the tobacco is developed, is not due to bacteria as was formerly supposed, but to the action of soluble enzymes present in the cells of the leaf. These enzymes are supposed to be highly organized forms of protoplasm and require for their work certain conditions of moisture, temperature, and ventilation.

The result of this discovery is likely to be far-reaching in its effect upon the manipulation of leaf tobacco and in the control of the product

derived from different soils. An interesting feature of this work, and one which shows the close relation to the soil investigation of the Division and fully justifies the work on the part of this Division, is the fact that the amount of enzymes appears to vary considerably with the locality and with the soil. Samples of the green leaf from certain localities contain a large amount of the enzymes, while the cured leaf contains practically none of the most active form. Investigations are in progress now to study the conditions which appear to have destroyed the active enzymes in the process of curing, with the expectation that if the cause of this is found the oxidizing agent can be preserved, so that tobacco from such lands can be fermented in the same way as the Florida and the Cuban leaf.

The investigations also indicate that tobacco raised on certain soils contain none of these enzymes, and it is thought that this may account for the occurrence of the nondescript tobaccos that are so often produced on soils outside of the recognized tobacco areas.

In accordance with the provisions in the last appropriation bill, preparations were made to start a field party in the work of mapping the soils of the Connecticut Valley, as already mentioned, and this work was started on the first of July, 1899. A manuscript map has already been prepared of a considerable area, showing the classification and distribution of the soils of the valley, and Dr. Loew is making a careful investigation of the chemico-physiological character of the leaf from these different soils.

It is an unquestionable fact that the different soils produce a very different grade of tobacco, and it is hoped that these investigations may throw light upon the reason for this difference, at least so that we shall understand more clearly than ever before the relation of soils to the character of the crop, and it is hoped that we will have more control than ever before upon the commercial crops that are grown in that locality.

Mr. M. L. Floyd, who has been identified with the remarkable advance made in the production of cigar-leaf tobacco in Florida, has been appointed on the Division staff to take part in these investigations on account of the technical knowledge and skill which he has acquired in the development of the Florida industry.

Mr. Floyd will be sent to Connecticut during the coming winter to cooperate with the Connecticut experiment station in the effort to ferment some of the Connecticut crop according to the Florida methods. Every means known to the Florida grower will be tried to develop a desirable flavor and aroma in the Connecticut tobacco, so as to approach more nearly, if possible, the Sumatra standard for light wrappers and the Cuban standard for a highly flavored filler in the different grades of leaf. Similar work is contemplated for several of the other tobacco districts, and it is believed that with this strong combination of workers much good will accrue to the tobacco growers of the country.

PARIS EXPOSITION.

In connection with the exhibit of the agricultural experiment stations, plans have been made for preparing an exhibit of the instruments and methods used for field investigations by this Division for the Paris Exposition of 1900. Three forms of electrical instruments are to be shown with their accompanying electrodes and equipments for field work.

Having been directed by you to prepare an exhibit of leaf tobacco from the United States for the Paris Exposition of 1900, considerable attention has been given to this subject, and the plans are well advanced for what promises to be a very fine display. Mr. M. L. Floyd has immediate charge of collecting the material. The responses to our written requests and personal interviews have been very generous, and hearty cooperation has been assured wherever it has been asked.

The greatest prominence will, of course, be given to the export tobaccos, as these are supplied to the foreign markets. In securing the material for this exhibit an effort has been made where possible to obtain a full line of samples from one person, firm, or association, as it is believed it will make a more uniform display than if individual samples were obtained to be brought together into a uniform exhibit. Nevertheless all available sources have been drawn upon for good material. It is proposed to make this a veritable commercial exhibit, showing all the different commercial grades recognized on the markets. A full line of such samples has already been promised from Maryland, Virginia, North Carolina, Kentucky, Tennessee, and Ohio. There will be a full display of cigarette tobaccos, particularly as these are coming into great demand in certain foreign countries. Our manufacturing types will also be fully represented, including smoking, chewing, and snuff tobaccos, and small samples of the products will be shown in connection with the leaf display to illustrate clearly the purpose and use of the different grades.

While prominence is to be given to the manufacturing and export types of tobacco, our own cigar types will be well represented, and plans have been made for a very fine display of the Southern types from Florida and Texas particularly, and of the Northern types from Connecticut, Pennsylvania, Ohio, and Wisconsin.

These will take in the principal commercial types of tobacco found on our market, and will illustrate the variety and extent of our tobacco supply. It is believed that the material in hand and promised, and the plans for the installation give assurance of a very creditable display of the leaf-tobacco products of this country.

CLERICAL WORK.

Rather more than the usual amount of clerical work has been done in the Division. The correspondence has increased appreciably and the library of the Division has received nearly 450 copies of books and pamphlets relating to soils, which have been catalogued. This library now contains about 1,500 volumes, including books and bound pamphlets.

The Division has 1,530 maps of all kinds, most of them having been catalogued. These are used as reference maps and as base maps for field work.

Two bulletins, three reports, three Farmers' Bulletins, and two articles for the Yearbook have been published by the Division. These make 265 printed pages as against 180 pages last year. Several bulletins and reports are in various stages of preparation.

REPORT OF THE AGROSTOLOGIST.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF AGROSTOLOGY,
Washington, D. C., August 29, 1899.

SIR: I have the honor to submit the fifth annual report upon the work of the Division of Agrostology for the fiscal year ending June 30, 1899, together with an outline of work for the current fiscal year and recommendations for the future, presented in accordance with your letter of instructions.

Respectfully,

F. LAMSON-SCRIBNER,
Agrostologist.

Hon. JAMES WILSON, *Secretary.*

WORK OF THE YEAR.

GRASS AND FORAGE-PLANT INVESTIGATIONS.

The work of grass and forage-plant investigations has been prosecuted along the several lines indicated in previous reports. The value and necessity of actual field work as well as the importance of experimental cultures of those grasses and forage plants which we may wish to propagate and introduce into cultivation are no longer questioned.

As stated in my last report, observations in the field have enabled us to understand the forage problems and needs of the several sections of the United States, and materially advanced our knowledge of the native grasses and forage plants, their distribution, their relative abundance, their value as they exist to-day, the peculiar conditions of soil and climate under which they best thrive, the means by which they may be propagated, and their possible value in agriculture or in the economic arts.

FIELD WORK.

No country offers so large a number of useful grasses and forage plants as are to be found in the United States. There are native species adapted to nearly every condition of soil and climate, and selections can be made from among these to meet almost every requirement of the farmer or the stockman. In order to secure information as to the best variety of crops to meet the needs of the various sections and climatic divisions of the country, it is necessary to study the conditions that there prevail—the soils, rainfall, drainage, and temperatures which govern the development of plants in a given area. To this end most of the Division force has been sent into the field or special agents employed to learn by direct observation the habits and distribution of native grasses and forage plants. Two agents were employed

to continue the work in the Southern States during the closing months of the last season, one working in Florida and another in Louisiana. Both made rich collections of most valuable material for the herbarium, and their field notes are of much importance in the work of the Division.

EXPERIMENTAL WORK.

The experimental work begun last year at Abilene, Tex., has been continued with excellent results, some of which have been outlined in Circular No. 8, published last December. The work being done at Abilene in testing methods of treatment of the ranges is one of considerable interest and much practical importance. In connection with this work trial tests are being made at Abilene with a number of varieties of grasses and forage plants, a report on which is in preparation. During the year the work has been extended to the Pacific coast, where field observations have been made in California, Oregon, and Washington. Experiments with grasses and forage plants have been made in eastern Washington at Yakima, in cooperation with the Northern Pacific Railroad, and at Wallawalla, in cooperation with the Oregon Railroad and Navigation Company. A large number of varieties have been tested during the season at Wallawalla, and among the more interesting and most promising varieties now being cultivated are Turkestan alfalfa from the dry regions of western Asia and oasis alfalfa from northern Africa. These varieties resemble the common alfalfa of this country, but it has already been manifest that the first named is more hardy, and it is believed that the latter will prove suitable for locations where irrigation is impossible. Smooth brome grass has shown wonderful vitality under most trying conditions of extremes of heat, cold, and drought, and slender wheat grass, with some of the native rye grasses, has shown ready adaptability to cultivated conditions and in good soil great productiveness. The blue grama has made excellent growth wherever it has been cultivated. If it can be successfully introduced upon the ranges of eastern Oregon and Washington, it will be a great boon to the stockmen of that country. Its power to resist trampling and drought gives it special value as a pasture grass, and upon rich, irrigated lands it is sufficiently productive to make a good hay grass.

Reference was made in my last annual report to varieties of perennial beans from the table lands of New Mexico. Seed of one of these varieties, known as Metcalfe bean, was procured in sufficient quantity to experiment with it in a number of localities. This bean has made a fine growth at Wallawalla, and may prove to be as valuable to the dry regions of the West as velvet bean is to the Gulf States.

COOPERATION OF FARMERS AND EXPERIMENT STATIONS.

The field experiments of the Division are being largely carried on through cooperation with prominent farmers in different parts of the country and with some of the State experiment stations, notably those of Tennessee, South Dakota, and California, and the results are so full of promise that it seems very desirable to have this experimental work extended still further. Some of the most valuable field investigations have been made in cooperation with the officials of the State institutions, as, for example, Prof. Aven Nelson's work in the Red Desert of Wyoming, the results of which were published in Bulletin No. 13 of this Division. Similar investigations are now in progress in

other portions of the country and are proving of great value as a means of ascertaining the resources and needs of the sections visited and a basis for future work. Early in the spring of the present year a plan for conducting cooperative range experiments with drought-resisting grasses at Highmore, S. Dak., was effected with the experiment station of that State. The work at Highmore is well advanced and is under the immediate management of one of the graduates of the State agricultural college. This plan of cooperation, which was made a special feature in the agricultural bill as passed by the last session of Congress, is most economical both for the Department and for the State authorities. It gives a wider interest and value to the investigations, and is certainly one of the best means of bringing the work of the Division in the closest touch with the people.

SAND-BINDING GRASSES.

The investigation of sand-binding grasses has been continued and observations on the native sand binders have been extended southward along the Atlantic coast to Florida, and also at various points along the Pacific coast and in the sandy regions of eastern Oregon and Washington. Some promising species of this group of grasses have been discovered, especially in the Pacific coast region, and experiments in propagating them have been undertaken. One variety, the seaside blue grass, which grows abundantly on the sand dunes along the coast of Oregon, has all the appearance of being a good forage plant as well as an excellent sand-binder, and seeds of this grass have been collected in considerable quantity for experimental cultivation. At the request of the War Department a number of grasses and other plants have been planted or sown on Tybee Island, at the mouth of the Savannah River. The variety which seemed most promising was the seaside oats, a tall strong-growing grass, native to the region.

HERBARIUM WORK.

An herbarium is an essential aid to the correct determination and classification of grasses. Here specimens of grasses from every country in the world are brought together and filed away in systematic order for ready reference. The collection of North American species in the herbarium is very full, giving it especial value for the study of the distribution of native species. The great value of the collection on account of its containing the types of a large number of species is fully recognized by botanists. During the past year 6,246 sheets of mounted specimens have been added to the collection, and the total number added during the past five years is 19,078. The duplicate specimens which have been accumulating for several years have been labeled and classified and arranged for distribution or exchange. The determination of specimens collected by our agents or of those sent in by correspondents for identification may be considered a part of the herbarium work to which much time has been given. Many thousands of specimens have been submitted to the Division for identification since its organization. Between 3,000 and 4,000 were determined for correspondents during the year.

PUBLICATIONS.

The publications issued from the Division the past fiscal year are as follows:

Divisional bulletins.—No. 13, The Red Desert of Wyoming and its Forage Resources, by Prof. Aven Nelson; No. 14, Economic Grasses, by F. Lamson-Scribner; No. 15, A Report upon the Forage Plants and Forage Resources of the Gulf States, by Prof. S. M. Tracy; No. 16, Range Problems and How to Meet Them, by Jared G. Smith; No. 17, American Grasses Illustrated—II, by F. Lamson-Scribner; No. 18, Studies on American Grasses, by Jared G. Smith; No. 19, Structure of the Seeds of Grasses with Reference to their Morphology and Classification, by P. Beveridge Kennedy.

Farmers' Bulletin.—No. 102, Southern Forage Plants, by F. Lamson-Scribner.

Circulars.—No. 7, Gram or Chick Pea, by Jared G. Smith; No. 8, Experiments in Range Improvement, by Jared G. Smith; No. 9, New Species of North American Grasses, by F. Lamson-Scribner; No. 10, *Poa fendleriana* and its Allies, by Thomas A. Williams; No. 11, Flat Pea, by F. Lamson-Scribner; No. 12, Rape, by Thomas A. Williams; No. 13, Beggarweed, by Jared G. Smith; No. 14, Velvet Bean, by Jared G. Smith; No. 15, Recent Additions to Systematic Agrostology, by F. Lamson-Scribner; No. 16, New Species of North American Grasses, by F. Lamson-Scribner; No. 17, Crimson Clover, by Thomas A. Williams.

Papers prepared for the Yearbook for 1898.—Millets, by Thomas A. Williams (subsequently printed as Farmers' Bulletin No. 101); Sand-binding Grasses, by F. Lamson-Scribner; Forage Plants for Cultivation in Alkali Soils, by Jared G. Smith.

It will be seen that during the year there were 7 divisional bulletins, 2 Farmers' Bulletins, 11 circulars, and 3 Yearbook papers, making 23 publications in all. Since the organization of the Division in 1895 there have been issued from it 19 bulletins, 18 circulars, 8 Farmers' Bulletins, and 12 articles for Yearbooks. These publications, including the annual reports, cover 2,026 pages of printed matter, 62 full-page plates, 1,177 figures, and describe 118 species of grasses new to science.

CULTIVATION AND DISTRIBUTION OF GRASSES.

The cultivation of grasses and forage plants on the Department grounds has been continued and has been a source of attraction throughout the season. This grass garden has given opportunity to those interested to note the appearance and habit of growth of a great number of important grasses and forage plants.

During the year the Division has distributed seeds of 185 varieties of grasses and forage plants in 1,609 packages. These seeds were chiefly of native varieties, and were for the most part collected through agents of the Division. They were nearly all sent to experiment stations or to correspondents who had requested an opportunity to cooperate with the Division in its work. Many interesting and valuable reports have been received on this account from all parts of the country, and are now being compiled for publication.

RECOMMENDATIONS.

An increase in the appropriations for the Division is necessary in order to provide for the natural growth of the work and to meet the greater and constantly increasing demands made upon it in the several lines of investigation now carried on. Public interest in the grass and forage plant investigations has greatly increased since the work was organized, and there is a pressing demand for the extension of these investigations into new fields. This is particularly true of the region west of the Rocky Mountains, where the forage plants of the cattle ranges have been practically destroyed over large areas. Urgent demands come to us from the Gulf Coast region, where the question of raising forage upon lands whose fertility has been exhausted by long-continued cultivation in cotton is now engaging serious attention of Southern planters. Testing the cultivation and management of improved forage crops on the abandoned farms of New England is in line with the work of the Division, and ought to be undertaken as a means of promoting the welfare and prosperity of a region which well might stand unrivaled in the profitable production of prime beef, mutton, and bacon. This work can be undertaken in cooperation with individual farmers, carefully selected in localities where the investigations will serve the widest purpose as object lessons. There can be no question as to the value and necessity of this work, and an increase in the appropriations is recommended in order to make it practicable to carry on the work effectively.

The holding of the drifting sands about the fortifications along the coast has been called to your attention by the War Department, and it is imperative that experimental trials of the known sand-binding grasses should be made in a number of localities where damage is being caused by blowing sands. Railroads whose lines pass through sandy districts where the drifting sands often seriously impede traffic and private parties or corporations whose lands are being made desert wastes by shifting piles of sand are demanding information which can only be afforded by practical demonstrations of the adaptability of certain grasses to fixing these destroying sand drifts. Inquiries concerning sand binders have come to us even from Japan, where the city of Niigata on the northwest coast is threatened with destruction by the sands blowing in from the sea. The State of Massachusetts has been making practical and, so far, effective tests with beach grass in holding the sand dunes of the Province Lands on Cape Cod. Similar experiments ought to be made along the South Atlantic and Pacific coasts, as well as along the shores of the Great Lakes, and an increase in the appropriation is urgently recommended in order that this work may be undertaken. The experience of the past year has shown the great desirability of securing seeds of native grasses and forage plants, especially those of the arid and semiarid regions, and those growing naturally upon alkaline soils for introduction into cultivation where such plants alone will survive. The distribution of thousands of packages of these seeds even in small lots has resulted in the accomplishment of much good. More abundant means for gathering these seeds in larger quantities is strongly recommended. There is hardly any line of work in the whole range of our investigations to which our funds can be more usefully directed. In order to carry out the investigations here indicated and continue the lines of work now well under way larger appropriations are required, and these recommendations are submitted in the hope that they will receive your favorable consideration.

REPORT OF THE DIRECTOR OF THE OFFICE OF EXPERIMENT STATIONS.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF EXPERIMENT STATIONS,
Washington, D. C., September 13, 1899.

SIR: I have the honor to present herewith the report of the Office of Experiment Stations for the fiscal year ending June 30, 1899.

Respectfully,

A. C. TRUE,
Director.

Hon. JAMES WILSON, *Secretary.*

WORK OF THE YEAR, WITH RECOMMENDATIONS.

DEVELOPMENT OF WORK OF OFFICE OF EXPERIMENT STATIONS.

In view of the increase in the business of the Office, due in part to its more intimate relations with American and foreign institutions for agricultural education and research and in part to new duties imposed upon it in connection with the Alaskan and irrigation investigations, it has been found advisable during the past year to organize the Office more thoroughly with relation to its different functions. Its business has, therefore, been more definitely divided into separate branches, for the direct management of each of which some one member of the staff has been made responsible; and in general, more complete arrangements have been made for the conduct of our business in such a way as to relieve the Director from the necessity of attending to numerous details and to give him greater opportunity and a more satisfactory basis for the consideration and determination of the more important matters requiring his decision. The work of the Office is now divided and assigned as follows: (1) Relations with American and foreign institutions for agricultural education and research, including the supervision of the expenditures of agricultural experiment stations in the United States, in immediate charge of the Director; (2) The Experiment Station Record, in charge of the Assistant Director, Dr. E. W. Allen; (3) Experiment Station Work and miscellaneous publications of the Office, in charge of Mr. W. H. Beal; (4) experiment stations in Alaska, in charge of Prof. C. C. Georgeson, with headquarters at Sitka; (5) nutrition investigations, in charge of Prof. W. O. Atwater, with headquarters at Middletown, Conn.; (6) irrigation investigations, in charge of Prof. Elwood Mead, with headquarters at Cheyenne, Wyo.

RELATIONS WITH AMERICAN AND FOREIGN INSTITUTIONS FOR AGRICULTURAL EDUCATION AND RESEARCH.

The work of the Office involved in its general relations with American and foreign institutions for agricultural education and research,

in immediate charge of the Director, may be conveniently described under the following heads: (a) Agricultural experiment stations in the United States; (b) American institutions for agricultural education; (c) Association of American Agricultural Colleges and Experiment Stations; and, (d) foreign institutions for agricultural education and research.

AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

ADVISORY RELATIONS WITH THE STATIONS.

With each succeeding year this Office comes into more intimate relations with the experiment stations in the different States and Territories. This has led to a steady increase in the amount of general advice and assistance which it has been called upon to render to the stations. This work is performed partly by personal conferences with station officers and partly by correspondence. It includes such things as advice regarding the organization and management of the stations; the choice of officers; the lines of work to be undertaken; the planning, recording, and execution of special lines of work; the nature and form of publications; the plans for station buildings; the materials, apparatus, and literature required for use in connection with different kinds of agricultural investigation. By its work in this direction the Office has been enabled to offset, to a certain extent, the difficulties in station management and work, especially those arising from frequent changes in the governing boards and staffs of the stations, and has secured an increasing amount of uniformity in the general policy of station management throughout the country. It has at the same time been clearly recognized that each station is an independent State institution, for the conduct of which the United States does not assume responsibility further than is involved in the requirements of the national law under which the stations are organized and the terms on which appropriations toward their maintenance are made year by year by Congress. The task of giving impartial and useful advice and assistance to the stations is, of course, in many ways more difficult than the direct supervision of their operations would be. Many impatient observers of the imperfections of our stations have jumped to the conclusion that it would be much better if their operations were controlled by central authority. Without doubt such supervision would immediately increase the efficiency of the stations in a number of the States where political and other untoward influences have contributed to weaken them. The number of instances of such unfortunate management is even yet sufficiently large to call for earnest criticism and protest; but, on the whole, the station enterprise in this country is steadily gaining in strength and importance, because it is, for the most part, managed in an intelligent and progressive way, and is securing results which commend themselves to an increasing number of intelligent farmers throughout the country. A proper local pride in the stations has already done much to strengthen them in many States, and during the past year the State legislatures have more than ever shown a disposition to aid the stations by liberal grants of State funds to provide better equipment or extend their operations. Without doubt this is in response to a popular demand for the extension of the station work, and shows that, after all, the plan of organizing them as State, rather than national institutions, is proving a success. A higher standard of

qualifications and efficiency is, as a rule, demanded of the candidates for station positions. This is especially true in the lines of agriculture and horticulture, where a larger amount of technical and scientific training is required than was formerly deemed necessary for persons occupying the positions of agriculturists or horticulturists in the stations.

SUPERVISION OF EXPENDITURES.

The fourth annual examination of the work and expenditures of the agricultural experiment stations which receive the national funds appropriated under the act of Congress of March 2, 1887 (Hatch Act), with special reference to the fiscal year ended June 30, 1898, was made during the past year in accordance with the authority conferred upon the Secretary of Agriculture by Congress, and a report of this investigation was prepared for transmission to Congress as required by law. This report was published as House Doc. No. 121 (Fifty-fifth Congress, third session), and a special edition, ordered by Congress for the use of this Department, was issued as Bulletin No. 61 of the Office of Experiment Stations and distributed to the governing boards and officers of the stations.

As heretofore, the report was based on three sources of information, viz, the annual financial statements of the stations, rendered on the schedules prescribed by the Secretary of Agriculture, in accordance with the act of Congress; the printed reports and bulletins of the stations; and the reports of personal examinations of the work and expenditures of the stations made during the year by the Director, Assistant Director, and one other expert officer of the Office of Experiment Stations. The stations in all the States and Territories were visited since the previous report was transmitted to Congress.

The following statements taken from the report indicate the financial conditions of the stations, especially in relation to the terms of the Hatch Act and the appropriation by Congress under that act:

During the past year the stations have as a rule steadily pursued their investigations. There have been a smaller number of changes in the workers, the general management has been less subject to radical and unwise changes, much useful work has been accomplished, and the facilities for investigations have been increased.

The financial business of the stations.—The views of this Department, representing the interests of the United States, have been more strictly followed than ever before in the conduct of the financial business of the stations. The account of the Hatch fund is quite generally kept distinct from that of other funds controlled by the station or the college of which the station is a department. Proper vouchers have in most cases been filed and the form of accounting recommended by this Department has been more generally followed. One point on which the Department has laid considerable emphasis is that the bills for expenditures under the Hatch Act shall be indorsed by the director or other executive officer of the station who is thoroughly familiar with the work of the station, as well as with the requirements of the Hatch Act. The adoption of this plan has not only made the accounts more regular, but has also led, in a number of instances, to a wiser expenditure of funds. The more fully the business of the stations is brought under the immediate direction of its expert officers the more surely will the operations of the stations be conducted in accordance with the spirit and intent of the law.

The substations.—In Wyoming and Arkansas the substations have been abandoned. Only in Colorado, New Mexico, and Arizona have regularly organized substations been maintained with the aid of the Hatch fund, and in these places the expenditures for this purpose have been diminished. These substations are of comparatively little value, since they are not manned by expert officers, and have not sufficient funds for their proper maintenance on the plan under which they

are organized. Substations are maintained, as formerly, in California, Minnesota, and Texas, where State funds have been provided to supplement the Hatch fund. In Connecticut, New York, and Alabama two separate stations are maintained with the aid of State funds, and in a similar way three stations are maintained in Louisiana.

Relation of colleges and stations.—There has been much activity during the past year in the developing and strengthening of courses of instruction in agriculture in the land-grant colleges with which the stations are connected. This has been to the advantage of the stations in a number of ways. The buildings and equipment of the colleges have been materially increased, and this has given the stations better facilities for their work. The instruction in agriculture has been specialized, which has necessitated the employment of a larger number of well-trained officers, many of whom have devoted a portion of their time to station work. The governing boards and general officers of the colleges are coming to see more clearly the real significance and importance of experiment-station work. They have, therefore, been more willing to make proper arrangements for the efficient conduct of this work and to pursue a more liberal policy toward the stations. In a number of instances there has been a more definite separation of the operations on the farms and in the barns, creameries, laboratories, etc., so that a definite place has been made for original investigations in agriculture, and these have been clearly differentiated from the work and facilities connected with instruction. It is coming also to be more clearly seen that care must be taken lest the routine duties connected with instruction shall so exhaust the energies of the officer employed in both college and station that he will not be able to devote his best energies to the more difficult task of originating and conducting successful investigations in agricultural science. The outlook is, therefore, more hopeful for the building up, in connection with these institutions, of strong departments of original investigation on behalf of agriculture, which shall not only accomplish great good by the practical results of the investigations disseminated among the farmers, but shall also materially aid in the proper development of courses of instruction in agriculture in the land-grant institutions.

The original investigations of the stations.—The past year has shown considerable progress in the importance and thoroughness of the original investigations pursued at our stations. The number of officers competent to undertake such investigations has been increased. There has been greater specialization of the work assigned to these officers. There have also been encouraging indications that cooperation between the officers engaged in different lines of investigation is being more efficiently secured. More attention is being given to the consideration of problems which affect in a general way important agricultural interests in the several States or are of fundamental importance in different branches of agriculture wherever pursued. * * *

Police duties of the stations.—The early work of our stations consisted largely in the determination of the chemical composition of commercial fertilizers with a view to protecting the farmer against fraud in the sale of such fertilizers. Out of this has grown the system of State inspection of commercial fertilizers, which has been generally adopted where the fertilizer trade has assumed any importance. The stations have from the first had a large share in the work connected with this inspection, and in a number of States the task involved in this inspection has grown to be very onerous. In a number of States the fees for fertilizer analyses have been sufficient to leave something of a balance which could be devoted to the more original work of the stations. More recently the investigations of the stations in other lines have shown the need of further inspection and control by the State of agricultural and horticultural industries. Laws have, therefore, been passed providing more or less fully for the control of the sale of foods, feeding stuffs, dairy products, and nursery stock. In many cases the station or one or more of its officers have been named in these laws as agents for conducting the inspection in whole or in part. In some cases this has led to the use of a portion of the Hatch fund to pay the expenses of inspection work required by State laws. This is obviously a diversion of that fund from its proper use. The inspection of any agricultural commodity with reference to its sale is wholly a routine matter, and the exercise of the control of its sale is a police duty belonging entirely to the State, or, in the case of interstate commerce, to the United States. The State should in all cases provide sufficient funds for the enforcement of its laws on this subject, and the governing boards of the stations should see to it that this routine work does not in any way interfere with the successful conduct of the original investigations called for by the Hatch Act.

Liberality of the States.—One of the most encouraging things connected with the progress of our experiment stations has been the disposition of the State legislatures to deal more liberally with them as the importance of their work has become more apparent. This liberality has manifested itself in a number of ways. There have been large grants of money directly for experiment-station purposes. In the erection of buildings for the colleges provision has often been made for increasing the facilities for experiment-station work. The printing of station publications is regularly done in a number of States at the public expense. The laws relating to inspection of agricultural commodities have been so framed that a considerable revenue has accrued to the stations for purposes of investigation. The increased means thus acquired have enabled the stations in a number of States to push their work far beyond what could have been accomplished with the Hatch fund alone.

Political interference and the injury to some stations thereby.—While as a rule our stations have been free from the baneful influence of the introduction of political considerations into their management, there are still some States and Territories in which politics have been a disturbing element in the affairs of the stations during the past year. This has resulted in unreasonable changes in the membership of the governing boards, the removal of efficient officers without cause or on inconsequential pretexts, and in a few cases in the appointment of notoriously incompetent men as station officers. This Department has consistently held that where such an unsettled state of affairs exists the real objects of the Hatch Act can not be attained, since these involve first of all a corps of competent specialists working under a well-defined policy outlined to cover a series of years of uninterrupted investigation and having an assurance that their work will be judged on its merits. It has not hesitated to protest against the action of governing boards wherever there was a plain case of violation of the proper principles of station management.

Statistics of the stations.—Agricultural experiment stations are now in operation, under the act of Congress of March 2, 1887, in all the States and Territories. As stated above, agricultural experiments have been begun in Alaska with the aid of national funds, and an experiment station is in operation in Hawaii under private auspices. In each of the States of Alabama, Connecticut, New Jersey, and New York a separate station is maintained wholly or in part by State funds, and in Louisiana a station for sugar experiments is maintained partly by funds contributed by sugar planters. Excluding the branch stations established in several States the total number of stations in the United States is 54. Of these, 52 receive the appropriation provided for in the act of Congress above mentioned. The total income of the stations during 1898 was \$1,210,921.17, of which \$720,000 was received from the National Government, the remainder, \$490,921.17, coming from the following sources: State governments, \$341,897.94; individuals and communities, \$177.20; fees for analyses of fertilizers, \$93,677; sales of farm products, \$65,356.25; miscellaneous, \$20,312.48. In addition to this, the Office of Experiment Stations had an appropriation of \$35,000 for the past fiscal year, including \$5,000 for the Alaskan investigation. The value of additions to equipment of the stations in 1898 is estimated as follows: Buildings, \$109,851.65; libraries, \$11,700.73; apparatus, \$19,195.43; farm implements, \$10,800.27; live stock, \$13,151.33; miscellaneous, \$11,972.97—total, \$176,469.41.

The stations employ 669 persons in the work of administration and inquiry. The number of officers engaged in the different lines of work is as follows: Directors, 75; chemists, 148; agriculturists, 71; experts in animal husbandry, 10; horticulturists, 77; farm foreman, 29; dairymen, 21; botanists, 50; entomologists, 46; veterinarians, 26; meteorologists, 20; biologists, 11; physicists, 11; geologists, 6; mycologists and bacteriologists, 19; irrigation engineers, 7; in charge of substations, 15; secretaries and treasurers, 23; librarians, 10, and clerks, 46. There are also 21 persons classified under the head of "miscellaneous," including superintendents of gardens, grounds, and buildings, apiarists, herdsmen, etc. Three hundred and five station officers do more or less teaching in the colleges with which the stations are connected.

During 1898 the stations published 406 annual reports and bulletins. Besides regular reports and bulletins, a number of the stations issued press bulletins, which were widely reproduced in the agricultural and county papers. The mailing lists of the stations now aggregate half a million names. Correspondence with farmers steadily increases and calls upon station officers for public addresses at institutes, and other meetings of farmers are more numerous each year. The

station officers continue to contribute many articles on special topics to agricultural and scientific journals. A number of books on agricultural subjects, written by station officers, have been published during the past year.

The schedules for the financial reports of the stations for the fiscal year ended June 30, 1899, as prescribed by the Secretary of Agriculture, have been forwarded to the stations, and the visitation of the stations with reference to the work and expenditures of that year is now in progress. It is believed that the work and expense involved in an annual visitation of the stations throughout the country are justified by the results. In no other way could so complete information be obtained regarding the expenditures of the stations as related to their work, and, as the terms of the Hatch Act are broad and general, many cases arise in which a satisfactory understanding of items of expenditure can only be reached by personal interviews. Moreover, the increasing demand on the part of governing boards and staff officers for the advice of this Office, above referred to, makes it more than ever desirable that representatives of the Office should frequently visit the stations.

Question having arisen during the past year as to the validity of the ruling of this Department regarding the use of experiment-station funds for college purposes, the opinion of the honorable Attorney-General on this subject was asked. His response confirmed the correctness of the ruling of this Department and strengthened its opinion, that no portion of the funds appropriated by Congress in accordance with the act of March 2, 1887, can legally be used, either directly or indirectly, for paying the salaries or wages of professors, teachers, or other persons whose duties are confined to teaching, administration, or other work in connection with the courses of instruction given in the colleges with which the stations are connected, or in any other educational institution; nor should any other expenses connected with the work or facilities for instruction in school or college courses be paid from said fund.

COOPERATION OF THE STATIONS WITH THIS DEPARTMENT.

The extent and variety of cooperation between the stations and various branches of this Department in the conduct of experimental inquiries have materially increased in recent years. This has been due in large measure to the development of more intimate relations between the officers of the Department and the stations, but beyond this such cooperation has been materially augmented by the action of Congress, in an increasing number of instances, in authorizing or directing cooperation with the stations in the appropriation act making provision for the maintenance of this Department. As long as these cooperative enterprises were few in number and limited in extent, they were easily and satisfactorily managed by more or less informal arrangements between individual officers of the Department and the stations. Under present conditions a more formal plan for arranging for such cooperation has seemed desirable. The governing boards and executive officers of the stations feel the necessity of having the terms of cooperative operations definitely stated and the whole transaction made a matter of record as a component part of the station business. It is also desirable that ample opportunity should be given for the station to consider how far and in what ways cooperation with the Department is desirable and to what extent its funds will be involved in such cooperation. In recognition of this need the Secretary of Agriculture made an order under date of February 28, 1899,

requiring the officers of this Department to submit their plans for cooperation with the stations for his approval before negotiating with the stations, and designating this Office as the representative of the Department in arranging for such cooperation and keeping a record of the cooperative enterprises agreed upon. Under this order the Department and the station each designate the officers who are to have immediate charge of the cooperative work in any given case, and these officers carry out the details of the plan agreed upon. This Office is thus made simply an intermediary for the arrangement of the cooperation and for the preservation of a record of its terms. A number of cooperative investigations have already been arranged for in this way. Recognizing the importance of this matter, the Association of American Agricultural Colleges and Experiment Stations, at its recent meeting in California, appointed a committee to confer with the Secretary of Agriculture on this subject and make a report to the association at its next session. Without doubt active cooperation between the stations and the Department may accomplish much toward strengthening and developing agricultural investigations in this country and securing from them results which can be readily and effectively applied to agricultural practice in different parts of the country. The different branches of the Department, having relatively ample facilities and means for special lines of investigation, can oftentimes conduct such investigations for the benefit of large regions of the United States more effectively than if such work is left to the State stations. In the development of methods of investigation and special apparatus, the Department can often accomplish much more than any one of the stations. On the other hand, the stations are to an increasing extent becoming centers of information and authority on lines of work in which they have been engaged with special reference to the local requirements of agriculture, and in some instances, through the liberality of the State governments or their connection with strong colleges or universities, are in better position than the Department to carry on investigations requiring the knowledge and skill of experts or expensive forms of special apparatus. By recognizing the authority of the stations in their several localities and securing the services of their expert officers and the use of the special facilities at their command, it is believed that the Department may oftentimes most economically and efficiently expend the funds intrusted to it by Congress for special investigations, and can at the same time devote the energies of its officers more fully and effectively to the larger enterprises for the promotion of the science and practice of agriculture.

EXPERIMENT STATION EXHIBIT AT THE PARIS EXPOSITION OF 1900.

An exhibit, designed to show the development and present status of the experiment station enterprise in this country, is being prepared for the Paris Exposition of 1900 by a committee of the Association of American Agricultural Colleges and Experiment Stations, of which Prof. H. P. Armsby, director of the Pennsylvania experiment station, is chairman. The Director of this Office is a member of this committee. The exhibit will consist of the publications of the stations and of this Office, photographs and charts showing the buildings and equipment of the stations and special features of their work and its results, an illustrated report on the history and present status of the stations, and a collection of special devices for station work and illustrations of notable results by means of models and otherwise. The

investigations in Alaska and in nutrition and irrigation, in charge of this Office, will also be included in this exhibit. Materials for the exhibit will be largely furnished by the stations. Space for the exhibit has been secured from the United States Commission to the Paris Exposition, which has also undertaken to transport, store, and care for the exhibit. As the central agency for the stations, a considerable share of the work involved in the preparation of this exhibit has devolved upon this Office.

AMERICAN INSTITUTIONS FOR AGRICULTURAL EDUCATION.

During the past year this Office has continued to collate and publish information regarding the agricultural colleges and other institutions for agricultural education in this country and to aid in promoting the interests of these institutions. Statistics relating to the agricultural colleges have been published in the same way as in the previous year. The Director of this Office has continued to act as a member of the committee on methods of teaching agriculture of the Association of American Agricultural Colleges and Experiment Stations. During the past year the committee has presented its third and fourth reports of progress to the association. These reports have included somewhat detailed outlines of courses of instruction in agronomy (plant production) and zootechny (animal husbandry). The Office has also aided the movement of the association which has for its object the securing of opportunities for the graduates of the colleges endowed by the National Government to continue their studies in connection with those branches of the Government at Washington which possess facilities for scientific study and research, as far as these may be utilized by students without interfering with the regular work of the Government. The Director of this Office has recently been appointed a member of the committee which is acting for the association in this matter.

The financial and statistical reports of the colleges receiving appropriations under the act of August 30, 1890, which, in accordance with the law, are regularly forwarded to the Secretary of Agriculture, have as hitherto been deposited in this Office, the last reports received being for the fiscal year ending June 30, 1899.

With the return of financial prosperity there has been enlarged liberality on the part of State legislatures in making provision for the maintenance of courses in agriculture at the land-grant colleges. In a number of States relatively large appropriations have been made for buildings to be used, in whole or in part, for agricultural instruction. A larger number of professors and other teachers in the several branches of agriculture have been employed and special efforts have been made to adapt the courses of instruction to the needs of various classes of students, as well as to meet the demands for practical instruction in special agricultural industries. More fully than ever the agricultural colleges are realizing that they have duties to perform beyond the giving of instruction to the students who come to them to pursue regular college courses. They are more and more reaching out to the farmers at their homes through various forms of university extension work. Encouraging progress has been made during the past year in the movement which looks to the introduction of nature teaching into the common schools. The great work in this direction inaugurated by the College of Agriculture of Cornell University has been materially extended in the State of New York during the past

year. The colleges in other States are taking up this work and in different ways are providing opportunities for teachers in the common schools to receive such special instruction as will enable them to successfully give elementary courses in nature study. As an example of this work, mention may be made of the successful summer school of agriculture and horticulture held this year at the University of Missouri. In that State a recently enacted law called for instruction in agriculture and horticulture in the common schools. At the invitation of the university a considerable number of school superintendents and teachers spent a number of weeks during the past summer in attending lectures and formulating elementary courses of instruction on these subjects.

Statistics regarding the farmers' institutes recently collated show that during the past year some two thousand institutes were held in different parts of the country, which were attended by about half a million farmers. The character of these meetings has in recent years undergone a decided change, which is believed to be due in large measure to the influence of the agricultural colleges and experiment stations. The farmers are now demanding that they shall receive at these meetings the best available expert information. The services of college and station officers are in such demand at the farmers' institutes that it is impracticable for these officers to do what the farmers desire in this direction without neglecting their other duties. Evidently there must be an enlargement of the force of experts available as lecturers at the institutes. As it requires special talent to successfully impart useful information at such meetings, it is believed that it will be necessary to organize a corps of institute workers. This has already been begun in this country, and is more largely practiced abroad. Persons engaged for this work should have broad training in the science, as well as in the practice, of agriculture and special knowledge of some branch of agriculture, to the teaching of which they especially devote themselves. They should mingle freely with practical farmers, so as to thoroughly learn their needs, and should be given opportunities to frequently visit the agricultural colleges and experiment stations, so as to keep well informed on the work of these institutions. The Department of Agriculture should be put in a position to more definitely and efficiently aid the farmers' institutes. It should have its special corps of institute workers to carry out to the farmers information regarding the work of the Department, which could often be more effectively presented to them through oral communications than by printed bulletins. We have not as yet fully realized in this country the importance of oral teaching of farmers on subjects relating to the progress of their art with which they are not familiar. In European countries much more use is made of oral teaching in this way. Without doubt the printed information so freely distributed by this Department and the experiment stations would be much more appreciated and utilized by the farmers if its nature and purport were explained to them by competent teachers and lecturers.

ASSOCIATION OF AMERICAN AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS.

The twelfth annual convention of this association was held at Washington, D. C., November 15-17, 1898. The Director of this Office was a delegate, and was also reelected bibliographer of the association.

The stenographic report of the proceedings was prepared under his supervision and has since been edited by the Director and Mr. W. H. Beal of this Office, and the chairman of the executive committee of the association, and issued as Bulletin No. 65.

The committee on indexing agricultural literature presented a library classification of agriculture, prepared by Mr. W. P. Cutter, Librarian of this Department.

The committee on methods of teaching agriculture presented as its third report of progress a syllabus for a college course in agronomy (plant production).

The committee on graduate study at Washington suggested as a tentative plan—

that Congress might be asked to provide for the establishment of an administrative office in Washington, preferably in the Smithsonian Institution, in which graduate students of the institutions we represent, and others as well, might be enrolled and directed to the appropriate Departments.

To maintain this office, pay the expenses of administration, support graduate courses of research, freely open to the graduate students of the land-grant and other colleges without distinction of race, sex, or color, on such terms as the administrative office should prescribe, and to aid such students in their researches, Congress might be asked to make an appropriation of, say, \$25,000, to be increased annually \$1,000, to be expended at the discretion of the Institution or Department in which the office of administration may be located.

The report of the committee was approved and the committee was continued.

The following resolutions were adopted:

Resolved, That this convention favors the introducing into public high schools and grammar schools of the several States of nature study and instruction in the elements of the economic sciences; and it is recommended to the colleges and other institutions concerned with agriculture and the mechanic arts that they endeavor to secure, if practicable, in their respective States such legislation or other action as may be necessary to introduce into the public schools the studies above named. For the training of teachers for giving instruction in these studies it is recommended that the colleges of agriculture and mechanic arts offer, if practicable, to teachers, in their summer vacations or at other appropriate times, courses of instruction in these subjects.

Resolved, That this association reaffirms its former action and earnestly urges upon all stations the use of the mailing lists prepared by the Office of Experiment Stations.

AGRICULTURAL EXPERIMENT STATIONS IN HAWAII, PORTO RICO, AND THE PHILIPPINES.

As agriculture is the leading industry in the islands which the United States has recently acquired, its encouragement and development through systematic agricultural investigations, such as are now undertaken under national auspices in all quarters of the world, will undoubtedly engage the serious attention of Congress in the near future. Doubtless special investigations in different lines by different branches of this Department will be found desirable in these islands, as they have been in other portions of the United States, but such investigations will not take the place of agricultural experiment stations, organized on a permanent plan, with special reference to the local requirements of agriculture. These stations will be needed in our island possessions just as much as they are in the States and Territories.

In a general way the organization and work of these stations may properly conform to the plan already in successful operation in this country. The island stations should, however, be organized more definitely with reference to the need of the people for information

already acquired through agricultural investigations elsewhere. Any plan for experiment stations in Hawaii, Porto Rico, and the Philippines should involve the following features: (1) A local station, with land, buildings, and equipment for field and laboratory investigations; (2) an agricultural survey, to study the agricultural capabilities and requirements of these islands; (3) cooperative experiments with resident farmers; (4) a dissemination, under frank, of bulletins of original and compiled information; (5) the holding of farmers' meetings in different localities for the diffusion of practical information. And in general, there should be a systematic effort to disseminate useful information on agricultural subjects among the people and to gain new knowledge, which may be utilized for the benefit of the agriculture of those regions. The importance of such a system of agricultural investigation and education has recently been recognized by the British Government in establishing a Department of Agriculture for the West Indies (see p. 130).

In the Hawaiian Islands a successful beginning of agricultural investigations has been made by the experiment station at Honolulu, established in 1894, by the Hawaiian Sugar Planters' Association, and carried on under the direction of Dr. Walter Maxwell, a chemist formerly employed in the Division of Chemistry of this Department and afterwards in the Louisiana Agricultural Experiment Station at New Orleans. This station has studied especially the problems relating to the culture of sugar cane and the manufacture of cane sugar, but there have also been experiments with fertilizers and an investigation of the soils of the islands. Advantage should be taken of the basis thus laid by local enterprise, and the United States Government should supplement the efforts of the people of these islands in this direction, as it has done in the States and Territories. In my judgment Congress would do well to provide, without delay, an annual appropriation of \$15,000 for the establishment and maintenance of an agricultural experiment station in the Hawaiian Islands. This appropriation should provide for the erection of buildings and all other expenses essential to the maintenance of an agricultural experiment station, as well as the printing (in the Hawaiian Islands), illustration, and distribution of reports and bulletins. This appropriation should be expended under the direction of the Secretary of Agriculture, as in the case of the appropriation for experiment stations in Alaska.

For Porto Rico an initial appropriation of \$5,000 should be made for an agricultural reconnoissance to determine the most desirable localities for the establishment of agricultural experiment stations and the institution of agricultural investigations, as well as to ascertain on what subjects the agricultural people of those islands are in most immediate need of practical information and how that need can be most economically and effectively supplied. Besides the payment of the salaries and traveling expenses of the agents employed in this reconnoissance, the appropriation should provide for the printing (in Porto Rico) and dissemination of circulars of inquiry and bulletins of information in the Spanish and English languages. This appropriation should be expended under the direction of the Secretary of Agriculture, and a report of the work should be made to Congress.

For the Philippines, provision should be made for a similar reconnoissance as soon as peace and order are established, and owing to the remoteness of these islands and the difficulties attending travel there, the initial appropriation should be at least \$10,000.

In order that these investigations may be promptly begun and actively prosecuted at favorable seasons, all three of the appropriations recommended for agricultural investigations in our island possessions should be made immediately available.

RELATIONS WITH FOREIGN INSTITUTIONS FOR AGRICULTURAL EDUCATION AND RESEARCH.

During the past year the Office has continued its efforts to secure definite information regarding the organization, equipment, and work of foreign institutions for agricultural education and research. For the first time the Office has published a list of the foreign experiment stations, including the name of each station, its location, and its director. A member of the Office staff, who has been studying in Germany on leave of absence during the past year, has brought back considerable useful information regarding the agricultural institutions of that country. Officers of experiment stations, sojourning abroad, have supplied this Office with numerous interesting items regarding the work of agricultural institutions in different countries. The Office has received during the past year visits from a considerable number of the officers of foreign agricultural institutions and much information regarding their work has been obtained through correspondence. It is evident that popular and governmental interest in agricultural education and research is everywhere increasing, and many countries are making a strenuous effort to perfect their systems of agricultural schools and experiment stations.

The Government of Russia has recently elaborated a plan for the establishment of a quite extensive system of agricultural education. The scheme provides for (1) higher education, furnished by independent agricultural institutes located in the chief agricultural zones of Russia, and by chairs of agricultural and allied sciences in the universities; (2) agricultural high schools, which are in the nature of technical schools and schools with courses in agriculture; (3) lower agricultural schools; and, (4) the diffusion of general agricultural information. There are now in Russia 3 schools for higher agricultural instruction, 9 agricultural high schools, 83 lower schools, and 59 special courses. Steps have already been taken for the establishment of about 50 additional agricultural schools.

In the Empire of Japan the organization and work of the agricultural experiment station has recently been much developed. There are at present in that Empire 10 experiment stations under Government control, besides 19 branch stations, the chief work of which is to teach farmers the application of the results obtained by the higher experiment stations.

In connection with the Imperial Department of Agriculture for the West Indies, recently established by the British Government, a comprehensive plan for agricultural education and research has been adopted. Four "central" and eight local experiment stations for the improvement of sugar cane will be established on the island of Barbados, and similar work will be prosecuted at Antigua, St. Kitts, and Trinidad. Botanic stations will be continued and developed at Tobago, Grenada, St. Vincent, Barbados, St. Lucia, Dominica, Montserrat, Antigua, and St. Kitts Nevis. An agricultural school has been opened at Dominica, and others will be started at St. Vincent, St. Lucia, and St. Kitts Nevis. Furthermore, "the department is

prepared to offer grants to enable certain institutions to employ teachers in agricultural science, and possibly provide a number of scholarships for the most promising pupils;" and in cooperation with the central educational authorities in each colony the teachers in the elementary schools will be given a course of instruction in the principles of agriculture, to enable them to give simple instruction and conduct school gardens. It is proposed to attach an agricultural instructor to each of the botanic stations, who will travel about holding meetings and demonstrations and imparting information on improved methods directly to the planters, and in addition instructors or experts in special lines, as budding and pruning fruit trees, curing tobacco, bee keeping, etc., will be employed to spend a month or two on each island.

PUBLICATIONS OF THE OFFICE.

During the year the Office issued 46 documents, aggregating 2,924 pages. These include 13 numbers of the Experiment Station Record, with detailed index, 13 bulletins, 8 Farmers' Bulletins (including 5 numbers of the subseries entitled "Experiment station work"), 3 circulars, 1 schedule, 3 articles for the Yearbook of the Department, the Annual Report of the Director, a report to Congress on the work and expenditures of the experiment stations, and 3 special articles published as separates.

EXPERIMENT STATION RECORD.

The Assistant Director of the Office has more completely exercised general supervision of the preparation of the Record, and has also continued to act as chairman of the abstract committee of the Association of Official Agricultural Chemists.

During the year the Record had been brought more nearly up to date than ever before and the amount of material supplied by the editors has considerably increased. The range of journals abstracted has also been extended. There is a growing demand on the part of station officers and other investigators that the abstracts in the Record shall in many cases be made longer so as to give a more adequate statement of the contents of the articles reviewed. This can not, however, be done without a larger editorial force and the printing of more frequent numbers of the Record. This journal is eagerly sought for abroad as well as in this country, and evidently meets a real need of students and investigators in agricultural science.

The tenth volume of the Experiment Station Record comprises 1,220 pages and contains abstracts of 361 bulletins and 35 annual reports of 53 experiment stations in the United States, 172 publications of the Department of Agriculture, and 1,224 reports of foreign investigations. The total number of pages in these publications is 57,230. The total number of articles abstracted is 2,023, classified as follows: Chemistry, 150; botany, 127; fermentation and bacteriology, 27; zoology, 23; meteorology, 46; air, water, and soils, 86; fertilizers, 109; field crops, 236; horticulture, 173; forestry, 34; seeds and weeds, 37; diseases of plants, 180; entomology, 202; foods and animal production, 223; dairy farming and dairying, 168; veterinary science, 86; technology, 6; agricultural engineering, 28; statistics, 82. Classified lists of articles, in some cases with brief abstracts, are also given in each number. The aggregate number of titles thus reported is 1,820.

Special articles are also published in the Record as follows: "Scandinavian seed-control stations," by F. W. Woll, assistant professor of agricultural chemistry, University of Wisconsin; "Physical and meteorological researches, principally on solar rays, made at the Station of Agricultural Climatology at the Observatory of Juvisy," by Camille Flammarion, director of the station; "Investigations on the metabolism of milch cows," by Oscar Hagemann, professor at the Agricultural Academy, Poppelsdorf, Germany; "Official methods of analysis of fertilizers and feeding stuffs adopted by the Belgian State laboratories and the agricultural experiment stations of Holland," translation from the bulletin of the Belgian Minister of Agriculture. There are condensed accounts of the Proceedings of the Fifteenth Annual Convention of the Association of Official Agricultural Chemists, 1898, and of the Twelfth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, prepared by W. H. Beal of this Office; and, in addition, editorial discussions of the following topics: The reading course as a factor in agricultural education; agricultural experiment stations in Japan; entrance requirements of the School of Agriculture, Ghizeh, Egypt; proposed scope of irrigation work by this Department, under the direction of the Office of Experiment Stations; life and works of Senator Justin S. Morrill and Dr. E. Lewis Sturtevant in their agricultural bearings; biological and dairy building of New York State experiment station; experiment station movement in Russia; agricultural experiment station in Alaska; agricultural appropriation act, 1899-1900; and summarized statistics of agricultural experiment stations and schools of agriculture receiving federal aid.

The completion of ten volumes of the Record has awakened a call for a general index covering this series. Without doubt such an index would be very useful, and it is hoped that the way may be opened for its preparation.

MISCELLANEOUS PUBLICATIONS.

The miscellaneous publications of the Office consist of (1) technical bulletins and (2) Farmers' bulletins, including the series known as Experiment Station Work, and are under the immediate supervision of Mr. W. H. Beal.

TECHNICAL BULLETINS.

Varieties of Corn (Bulletin No. 57), prepared by E. L. Sturtevant, formerly director of the New York State Experiment Station, and edited in this Office, is a monograph on this subject in which about 800 varieties or synonyms are treated and an attempt made to place the nomenclature upon a sound scientific basis. A system of classification has been adopted in which the closely related forms are brought together and the very considerable duplication of varieties shown.

Organization Lists of the Agricultural Colleges and Experiment Stations in the United States, with a list of Agricultural Experiment Stations in Foreign Countries (Bulletin No. 59), contains a list of experiment stations in the United States with their governing boards and working staffs; a list of agricultural schools and colleges in the United States with courses of study and boards of instruction; a list of the officers of the Association of American Agricultural Colleges and Experiment Stations and of the Association of Official Agricultural Chemists in the United States; a list of experiment stations in

42 foreign countries, with their location and directors; list of station publications received by the Office of Experiment Stations during 1898; federal legislation affecting agricultural colleges and experiment stations, and regulations and rulings of the Federal Departments affecting the stations.

A Report on the Work and Expenditures of the Agricultural Experiment Stations for the year ended June 30, 1898 (Bulletin No. 61), contains the report of the Director of this Office described on page 121.

A Second Report to Congress on Agriculture in Alaska (Bulletin No. 62), includes the report of Prof. C. C. Georgeson, special agent in charge of the Alaska investigations, and of Dr. W. H. Evans, botanist of this Office, as described in the account of the Alaska investigations given on page 137 of this report.

Statistics of the Land-Grant Colleges and Agricultural Experiment Stations in the United States for the year ended June 30, 1898 (Bulletin No. 64), is a compilation showing the number of officers and students, endowment, equipment, and revenue of the colleges, and the number of officers, revenues, expenditures, lines of work, and number of publications of the stations.

Proceedings of the Twelfth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, held at Washington, D. C., November 15-17, 1898 (Bulletin No. 65), contains, in addition to the proceedings of the convention, papers, addresses, and reports on a number of subjects of interest to students and investigators in agricultural science. The stenographic report of these proceedings was made under the supervision of this Office, and the proceedings were edited for publication by the Director of this Office and the chairman of the executive committee of the association.

A brief statement regarding other bulletins issued in connection with the work in nutrition and irrigation may be found on pages 141 and 149, respectively.

FARMERS' BULLETINS.

Corn Culture in the South (Farmers' Bulletin No. 81), by S. M. Tracy, formerly director of the Mississippi Agricultural Experiment Station, is intended to encourage the more extensive growing of corn in those portions of the South where its culture has hitherto been more or less neglected. It contains practical information on the culture, fertilizing, storage, and varieties of corn, and is based on the results of station work in the Southern States and elsewhere and on the author's wide acquaintance with Southern agricultural conditions.

Fish as Food (Farmers' Bulletin No. 85), by C. F. Langworthy, of this Office, contains a discussion of the composition, nutritive value, and digestibility of fish, as well as of its place in the diet, and statistics showing the importance of the fishery industry in the United States. The work is largely based on the investigations of Prof. W. O. Atwater, special agent in charge of the nutrition investigations of this Department, on the chemical composition and nutritive values of food fishes and aquatic invertebrates, the results of which were published in the reports of the United States Fish Commission for 1880, 1883, and 1888; other publications of the Fish Commission; on the reports of the New Jersey Experiment Stations; and on data from other authoritative sources.

Sugar as Food (Farmers' Bulletin No. 93), by Mrs. Mary H. Abel, contains a useful summary of available information concerning sugar

as a food and of its use in the dietaries of adults and children. In preparing this article Mrs. Abel has made an extended study of the literature of the subject and has had the opportunity of discussing doubtful points with specialists in physiology and hygiene. The work of the Division of Chemistry of this Department has been drawn upon, as well as the nutrition investigations conducted under the direction of this Office.

EXPERIMENT STATION WORK.

Experiment Station Work VI, VII, VIII, IX, X (Farmers' Bulletins Nos. 79, 84, 87, 92, 97), are five numbers of a subseries of brief popular bulletins compiled from the published reports of the agricultural experiment stations and kindred institutions in this and other countries. Each of these bulletins contains a number of short articles, summarizing the results of recent investigations in different lines and explanations of the technical terms necessarily employed in describing the results of investigations on certain subjects. As stated in the prefatory note in each number, "the chief object of these publications is to disseminate throughout the country information regarding experiments at the different experiment stations and thus to acquaint our farmers in a general way with the progress of agricultural investigation on its practical side." In order to make these articles most interesting and useful to farmers, it has been deemed essential to make them something quite different from ordinary abstracts of single articles or bulletins. It is often necessary to interweave, skillfully, the results obtained in several investigations; explanations of the local and other limitations of the results of certain experiments must be made, and in general such explanatory matter must be introduced as will make each article a clear and intelligible presentation of the subject to the farmer reader. Popular composition of this description, which combines scientific accuracy with a clear and entertaining style, is, of course, a difficult task. We believe, however, that every reasonable effort should be made to provide our farmers with the best attainable products of editorial and typographical work. As was expected, the real purpose and value of this new series of popular bulletins were not at first fully understood, but as the number in the series has increased the demand for the different issues has rapidly grown. It is proposed to publish an index to the different numbers as often as the number of subjects will warrant. In this way recipients of this series, who preserve and bind together the several volumes with the indexes, will have a readily accessible store of information on a large number of subjects directly related to farm practice. The aim will be to provide our farmers with a popular record of the progress of agricultural research. How useful this will be to them will of course depend largely on the care which they take to secure, read, and preserve the bulletins provided for their benefit.

Now that many preliminary questions regarding the form and content of Experiment Station Work have received much consideration, it is hoped that it will be possible to increase the annual output of numbers of this series. This can not, however, be done to any considerable extent with the force at present available for this work.

CARD INDEX.

Copy for 1,400 cards of the Index of Experiment Station literature has been prepared in this Office and forwarded to the printer during

the year. The number of index cards distributed has reached 17,600. The receipts from sales of this index during the past year have been \$84.

BIBLIOGRAPHICAL WORK.

A list of 452 works on agricultural subjects, most of which were issued during the past two years, was prepared, together with brief statements showing the scope and character of the books included in the list and published as Circular 38 of this Office. There has also been prepared in the Office a bibliography of about 1,000 titles on bread and kindred topics; one of 1,500 titles on the general subject of the nutrition of man and animals; and one of about 450 titles on the literature of nitrogen assimilation of plants, supplementary to that published in 1894 by D. T. MacDougal, Minnesota Botanical Studies, Bulletin 9. In this work the Office has, as hitherto, received the cordial cooperation of the Librarian of the Department and his assistants.

The Office has continued to collect and catalogue the publications of the agricultural colleges and experiment stations in this and other countries. The number of exchanges of foreign publications containing reports of agricultural investigations which have been received and transmitted to the Department Library has been fully as large as heretofore. The receipt in the Library of several thousand numbers of periodicals from all parts of the world has been brought to the attention of the editorial force engaged in the preparation of the Experiment Station Record.

WORK FOR THE CIVIL SERVICE COMMISSION.

The work performed by this Office, as the general representative of the Department, in its dealings with the Civil Service Commission has been considerable. This has included numerous personal conferences with the Commission and its officers regarding the nature and scope of examinations. Much pains has been taken to explain to the Commission the actual requirements for positions in the scientific service of this Department. While this has taken considerable time, it is believed that the results have been very useful. Besides the general examinations for assistants, in the preparing and rating of questions for which all the Divisions of the Department shared, 15 special examinations were held during the year. The number of papers received from the Commission, recorded in this Office, and rated by examiners in the Department during the year was 525. The eligible list of assistants established by annual examinations has been useful to other Departments, and persons who have passed this examination by this means more readily obtain situations in the agricultural colleges and experiment stations. By conference with the Commission, a satisfactory arrangement was made for the establishment of a register of graduates of the land-grant colleges, to be known as "scientific aids." A considerable number of graduates of these institutions complied with the conditions of this register, and their papers are now being examined and rated.

EXPERIMENT STATIONS IN ALASKA.

The second appropriation "To enable the Secretary of Agriculture to investigate and report to Congress upon the agricultural resources of Alaska, with special reference to the desirability and feasibility of

the establishment of agricultural experiment stations in said Territory and the selection of suitable locations for such stations," became available July 1, 1898. With the aid of a small portion of the first appropriation for these investigations, which remained unexpended after the report to Congress on the preliminary survey of the agricultural conditions and possibilities of Alaska, made during the summer of 1897, had been prepared, Prof. C. C. Georgeson was appointed special agent in charge of Alaska investigations and sent to that Territory in the spring of 1898, arriving at Sitka May 12. It was arranged that headquarters for the work of this Office in Alaska should be established at Sitka, and it was hoped that quarters might be obtained in the Government building there, but this did not prove feasible. After some difficulty a temporary lease of a small house was secured. This building was poorly suited to the requirements of our work. Arrangements were at once made with a number of persons having gardens in Sitka, by which Professor Georgeson was enabled to make experimental plantings of seed of over 100 varieties of vegetables, grain, grasses, and flax, which he had taken with him for that purpose. Seeds were distributed in a number of different localities in Alaska, and measures were instituted to obtain information regarding the crops, methods of culture, keeping of animals, and agricultural possibilities of different regions.

On June 7, 1898, Dr. W. H. Evans, botanist of this Office, proceeded to Alaska and continued the botanical survey of the coast region, which he had begun the previous summer.

The work in charge of Professor Georgeson during the summer of 1898 was in the following lines:

(1) Experiments in growing different varieties of cereals, forage plants, flax, and vegetables in gardens placed at his disposal by citizens of Sitka. In spite of the late planting, oats, barley, flax, potatoes, and a number of different kinds of vegetables of good quality were matured, and clover and grasses made an excellent growth. Useful data were also obtained from these experiments regarding the effect of different soil conditions on the germination of seed and the growth of plants.

(2) Experiments similar to those at Sitka, but more restricted in variety, were made at Skagway, with the aid of Mr. George Sexton, a resident of that place.

(3) Observations and records of the soil temperatures were made at Sitka and Skagway, and arrangements for similar observations were made at a few other places.

(4) Samples of soils were collected at Sitka and at Kenai, in Cook Inlet, of which moisture and other determinations were made under the direction of the chief of the Division of Soils of this Department.

(5) Circulars of inquiry regarding agricultural conditions in different parts of Alaska, including both the coast region and the interior, were sent out, and a number of replies were received and reported.

(6) A number of places in the coast region of Alaska were visited, and surveys and reservations of land for experimental purposes were made at Sitka, Kadiak Island, and Kenai, in Cook Inlet.

The botanical survey conducted by Dr. Evans was of shorter duration than that of the previous year, and, owing to the lack of transportation facilities, comparatively few places were visited. A considerable number of new specimens of the flora of the coast region were, however, collected. Several species were found which may prove of considerable value as sand binders, for which there is great need in many localities in the United States.

Reports on their work were prepared by Professor Georgeson and Dr. Evans, under the supervision of the Director of this Office, and were transmitted to Congress in January, 1899. These reports were first published as Document No. 169 of the House of Representatives, Fifty-fifth Congress, third session, and afterwards as Bulletin No. 62 of this Office.

As the results of these investigations were sufficiently favorable to justify the continuance of agricultural investigations in Alaska, Congress made a third appropriation for this work for the current fiscal year, increasing the amount from \$10,000 to \$12,000, of which sum \$7,000 was made immediately available. The Secretary of Agriculture was authorized to expend this fund "to investigate and report to Congress upon the agricultural resources and capabilities of Alaska, and to establish and maintain agricultural experiment stations in said Territory, including the erection of buildings and all other expenses essential to the maintenance of such stations." As the terms of this appropriation indicated that experiment stations were to be regularly maintained in Alaska, as in other parts of the United States, plans were made for putting our work in that Territory on a permanent basis. As it was decided that, on the whole, Sitka, the capital of Alaska, would be the most convenient place in which to establish an office and laboratory and from which to supervise investigations along the coast, as well as in the interior, and to disseminate information regarding these investigations to different parts of the Territory, it was deemed essential that a building should be erected at that place which might serve as headquarters for these investigations. Plans were therefore drawn for a building which should contain offices, laboratories, and quarters for the special agent in charge. The plans provided for a simple but substantial wooden building, containing 10 rooms, to be built at a cost of about \$5,000. Castle Hill, a lot in Sitka which a number of years ago was set aside as a site for Government buildings, which were afterwards located elsewhere, was selected as the site for the experiment station headquarters, having been reserved for this purpose by an order of the President. As the amount of the appropriation was not sufficient to warrant an expenditure for this building large enough to complete it, it was decided to make a contract which would provide for inclosing the building, completing the roof, and finishing the lower story during the present year. Bids were therefore called for on these terms, and the contract was awarded to the lowest bidder, Mr. George E. Jones, of Juneau, Alaska, for the sum of \$3,700. The building is now well advanced, and it is expected that the work contracted for will be finished by the middle of September.

The regular force for the Alaska investigations was increased by the appointment of two assistants and one laborer, and provision was made for engaging the services of other temporary assistants and laborers as occasion demanded and the funds for this work permitted. A considerable number of farm implements and four work oxen were purchased.

Arrangements were made for the clearing of land for experimental purposes at Sitka and at Kenai (in Cook Inlet), on the reservations made for that purpose the previous summer. Preliminary investigations were also begun at Kadiak. Seeds were distributed to a number of persons in different localities in Alaska, who agreed to report the results of trials with them. The Weather Bureau having determined to move the headquarters of its Alaska service from Sitka to Eagle, in

the interior, it was arranged that Professor Georgeson should have supervision of meteorological observations at Sitka and a few other points in the coast region, and that the officers in charge of the Weather Bureau should assist this Office in obtaining information regarding the agricultural capabilities of the interior.

Besides the erection of the headquarters building and the clearing of land, Professor Georgeson was instructed to continue experiments with different crops at Sitka, to study the soil and its treatment, and, if practicable, to make experiments in the preservation of forage crops in the silo.

The following extracts from the progress report made by Professor Georgeson under date of August 17, 1899, will serve to show what is being done in these lines during the present season:

I arrived at Sitka April 6 with my two assistants, one laborer, four work oxen, and the implements purchased for use here. At that date there was still snow on the ground everywhere except spots having a southern exposure, and occasional snow storms continued to occur until the end of the month, and we had frequent and heavy rain storms. Little work could be done in the way of preparing and seeding ground until the latter part of April, and conditions were not favorable for outdoor work before the middle of May. The season was abnormally backward and cold, a condition which was not peculiar to Alaska, but prevailed over the entire United States. Early planting was useless, as the seed did not germinate. However, we finished seeding our experimental crops May 18. June averaged 10 degrees colder than June of last year, and growth was slow until the latter part of that month. July and the first half of August have been favorable, and at this writing the grains are nearly as far advanced as they were last year at this time. In fact, some of the earlier varieties of barley have begun to turn yellow.

The crops consist of many varieties of barley, oats, spring wheat, and spring rye, also buckwheat, flax, field peas, vetches, grasses, and other forage crops. We have also growing an extended list of vegetables, but only a sample, so to speak, of each variety. The grains receive our chief attention. All kinds of hardy vegetables have passed the experimental stage in the coast region of Alaska; they can be grown to perfection. The grains have, on the other hand, never been tried here before, and it is as yet problematical what kinds can be grown here successfully. I find a wide difference in the adaptation of different varieties of the same grain, and for a few years to come the pioneer work of testing varieties will be of importance, till we ascertain which, if any, can be relied on to mature. Including everything, we have upwards of 200 separate plats growing and under observation the present year.

The land occupied by these crops consists of garden patches scattered all over the town. All told, we occupy twelve such patches. They have, with two exceptions, been tendered rent free by the people who own them. Some of them are new ground, others had been in seed for several years, since they were cultivated; in either case the soil could not be put in the best condition for cropping the present year. The meager growth on new soil which was observed last year is again shown, but a dressing of quicklime on the soil at the rate of about 2 tons to the acre improves the growth of barley, oats, buckwheat, and peas materially.

At this writing the prospects are that all the barley, flax, buckwheat, and peas and several of the earlier varieties of oats will mature, but wheat and spring rye are uncertain.

Much difficulty was experienced in obtaining suitable laborers to assist in the work at Sitka, and the task of clearing and draining the land proved more formidable than was expected. Some 4 acres of new ground on the station reservation have, however, been cleared and partially drained. A road has also been built along one side of the farm and up to the station building on Castle Hill. It was expected that log buildings, as quarters for one assistant and for the oxen and implements, would be erected on the reservation this season, but this has been found impracticable and temporary quarters have been secured in the town of Sitka. Through the courtesy of Hon. J. G. Brady, governor of the Territory, an arrangement was made to fill a silo on his place and feed the station oxen at his barn during the coming winter.

The work at Kenai has been in immediate charge of Mr. H. P. Neilson, who, with the aid of one laborer, has accomplished a relatively large amount of work. Professor Georgeson has visited this place and reported on the work there under date of August 3, 1899. There being no cultivated land available for use, it was necessary to use new ground.

In spite of the fact that new ground is not favorable to the growth of crops, the vegetables and grains were doing well. The grains were short but healthy, and they will probably mature seed. The season has been unusually dry there this year and the crops were in need of rain. About 3 acres of land have been cleared at Kenai and a combined log barn and implement shed erected. A log silo has also been constructed and filled with native grasses. Several tons of hay have been made from the grasses growing in the vicinity. Provision has thus been made for the maintenance during the winter of the yoke of oxen used in connection with the station work at Kenai.

At Kadiak the preliminary investigations have included the growing of vegetables and grain. The season has been unusually dry, which makes it doubtful whether the crops will mature before killing frosts come.

A complete and satisfactory report of operations in Alaska during the present season can not, of course, be made at this time, but our present advices indicate that the work is proceeding in a satisfactory manner and that no greater difficulties have been encountered than might have been expected. Necessarily a relatively large amount of time has been given to the erection of buildings and clearing of land during the present season, but it is believed we shall have considerable useful information regarding agricultural conditions in Alaska to report at the end of the season, in addition to that reported last year. The remoteness of the region, the inadequate and expensive means of transportation, and an insufficient and high-priced supply of labor materially increase the cost of agricultural investigations in Alaska. The work in Alaska, moreover, does not receive any financial aid such as is directly or indirectly given to the stations in other parts of the country, either by the State governments or by the colleges with which the stations are connected. In view of these facts and the need of additional funds for the completion and equipment of the station headquarters, it is hoped that the appropriation for the Alaska stations will be increased next year to the same amount as is given to each of the other stations, \$15,000, and that half of the appropriation will be made immediately available.

NUTRITION INVESTIGATIONS.

The investigations "upon the nutritive value of various articles and commodities used for human food," with Prof. W. O. Atwater special agent in charge, have been continued during the past year, as hitherto, in cooperation with the agricultural experiment stations, agricultural colleges, and other educational institutions. The headquarters for these investigations have remained at Middletown, Conn., where the work is carried on in cooperation with the Wesleyan University and the Storrs Experiment Station. The work conducted there consists of special investigations with the bomb and respiration calorimeter; the revision and preparation for publication of the reports received from the agents employed to conduct nutrition investigations in different parts of the country; the compilation of results of nutrition investigations conducted in different parts of the world; the correspondence necessarily required by general supervision of nutrition investigations

and by the demands for information regarding the nutrition of man, coming from a great variety of sources. Besides the work done for this Department, a large amount of investigation is carried on under the immediate direction of Professor Atwater for the Storrs Experiment Station, the lunacy commission of the State of New York, and the committee of fifty for the investigation of the drink problem, for which this Department is in no way responsible. These outside investigations, however, contribute much information which is utilized in connection with the Department work and in a number of ways helps to make our investigations more efficient and successful.

A considerable number of investigations with the respiration calorimeter, in which a man was inclosed in the respiration chamber for periods varying from three to nine days in duration, have been successfully conducted during the past year. These investigations include both metabolism and digestion experiments. Considerable attention has also been devoted to the further elaboration of the methods of metabolism investigations.

The work in connection with the study of the food consumption of university boat crews which was undertaken in the spring of 1898 has been completed during the year, and an elaborate study of the food consumption of bicycle racers, including dietary studies and digestion and metabolism experiments, has been carried on. These studies of the food consumption of athletes, it is believed, will materially add to our knowledge of the food consumption of people with severe muscular work.

A quite extended study of the nutritive value of canned meats was made in connection with inquiries conducted by the War Department regarding the meat rations furnished to the Army during the war with Spain. Part of this work was performed for this Department and part directly for the War Department.

More bulletins than usual were prepared for publication during the past year. Material worthy of publication has, however, accumulated very rapidly as these investigations have proceeded, and a larger force would be required to enable the Office to prepare publications more promptly. The rapidly increasing interest in questions relating to the nutrition of man has caused an increase in the general correspondence of the Middletown office, and it has been found impracticable to satisfy all demands in this direction with our present force without interfering with the progress of investigations.

Investigations on the nutritive value of bread and cereals have been carried on in Maine, at Orono, by Prof. C. D. Woods, in cooperation with the University of Maine, and in Minnesota, at Minneapolis, by Prof. H. Snyder, in cooperation with the University of Minnesota; digestion experiments with men with special reference to the effect of muscular work upon the metabolism of nitrogen and experiments in the digestibility and palatability of bread made from cotton-seed meal in Tennessee, at Knoxville, by Prof. C. E. Wait, in cooperation with the University of Tennessee; dietary and digestion experiments in which fruit formed a considerable part of the diet in California, at Berkeley, by Prof. M. E. Jaffa, in cooperation with the University of California, and investigations on the effects of cooking upon the nutritive value of meat in Illinois, at Urbana, by Prof. H. S. Grindley, in cooperation with the University of Illinois.

Besides general business relating to the supervision of the nutrition investigations, the Washington office has done considerable work

during the past year in perfecting the details of reports of investigations, especially in bibliographical lines, in making abstracts of the literature of nutrition, partly for publication in the Experiment Station Record, in conducting a large amount of correspondence relating to the nutrition of man, and in distributing publications on this subject.

The special effort which this Office has made to secure the dissemination of the results of nutrition investigations among teachers and students in schools of all grades throughout the country is bearing fruit in a wide demand for the Department publications on this subject and for information on special points not touched upon in these publications.

While the nutrition investigations of the Department have increased in extent and importance in recent years and the demand for information, much of which can only be obtained through further investigations, has grown to large proportions, the annual appropriation for this work has not been enlarged. If the Department is to accomplish in this line of work what the importance of the subject and public interest in definite and accurate information regarding the nutrition of man demand, increased funds should be put at its disposal. I therefore heartily indorse the recommendation of Professor Atwater that the appropriation for nutrition investigations for the ensuing fiscal year be increased from \$15,000 to \$20,000. Such an increase would enable the Office (1) to extend its investigations of the actual food consumption and food economy of people of different occupations in different parts of the United States; (2) to carry on more thorough investigations of the nutritive effects of alcohol and alcoholic beverages than it has been practicable to make under private auspices; and, (3) to prepare a larger number of popular summaries of results of nutrition investigations and otherwise aid in the development of the science of home economics and its application in household practice as well as its teaching in the schools.

FOOD AND NUTRITION PUBLICATIONS.

Seven bulletins on subjects relating to the food and nutrition of man have been issued from this Office during the past year.

The Chemical Composition of American Food Materials (Bulletin No. 28, revised edition) contains the maximum, minimum, and average of over 4,000 analyses of American food products, and includes a large number of analyses made since the first edition was issued. - As a standard table of food analyses it is therefore much more complete and satisfactory than any table which has preceded it.

Dietary Studies in Chicago in 1895 and 1896 (Bulletin No. 55), by W. O. Atwater and A. P. Bryant, contains a report on the food habits of fifty foreign and three American families in the congested West Side of Chicago. The work is similar to that carried out with typical families in the densely populated districts of New York City and reported in Bulletin 46 of this Office. In the prosecution of these investigations this Office has had the cooperation of Miss Jane Addams, Miss Caroline L. Hunt, and others, of Hull House.

History and Present Status of Instruction in Cooking in the Public Schools of New York City (Bulletin No. 56), by Mrs. Louise E. Hogan, with an introduction by the Director of this Office, contains the history of the development of this movement in the public schools of New York City with a somewhat detailed account of the course of instruction and exercises.

Description of a New Respiration Calorimeter and Experiments on the Conservation of Energy in the Human Body (Bulletin No. 63), by W. O. Atwater and E. B. Rosa, contains a description of a respiration calorimeter of special construction and of experiments with the apparatus on the metabolism of matter and energy and the conservation of energy in the human body.

The Physiological Effects of Creatin and Creatinin and their Value as Nutrients (Bulletin No. 66), by J. W. Mallet, contains the results of a number of experiments to determine the physiological effects of these bodies (which are the principal organic constituents of meat extracts) and of many comparative tests of their chemical properties.

Fish as Food (Farmers' Bulletin No. 85) and Sugar as Food (Farmers' Bulletin No. 93) contain a considerable amount of information derived from the reports of the nutrition investigations and elsewhere (see p. 133).

Three other bulletins were sent to press and the manuscript of four more was substantially completed.

IRRIGATION INVESTIGATIONS.

The first appropriation for these investigations became available July 1, 1898, and was "for the purpose of collecting from agricultural colleges, agricultural experiment stations, and other sources, including the employment of practical agents, valuable information and data on the subject of irrigation, and publishing the same in bulletin form." General supervision of these investigations having been assigned to the Director of this Office by order of the Secretary, steps were at once taken to ascertain in what direction the work should immediately proceed. As preliminary measures, the literature of irrigation, especially that containing accounts of experimental inquiries, was collated and reviewed, and correspondence was had with experiment station officers, State engineers, and other experts who had devoted their energies to studies of irrigation problems in this country. A conference of station officers and State engineers was held in Denver, July 12 and 13, 1898, at which the needs of agriculture under irrigation were earnestly considered and much useful advice regarding the plans for the work of this Office was obtained. As a result of these preliminary inquiries, it was determined to limit the work of the Office on irrigation under this appropriation to two general lines: (1) The collation and publication of information regarding the laws and institutions of irrigated regions in their relation to agriculture, and (2) the publication of available information regarding the use of irrigation waters in agriculture as determined by actual experience of farmers and experimental investigations, and the encouragement of further investigations in this line by the experiment stations. On account of his broad training and successful experience as a student and administrator of irrigation problems, Prof. Elwood Mead, State engineer of Wyoming, was asked to undertake the direct management of the investigations in charge of this Office. The appropriation would not, however, admit of his full employment in this capacity, and the laws of the State of Wyoming would not allow his holding a federal office at the same time that he was an officer of that State. He was, nevertheless, employed in a temporary way under special contracts, and thus materially assisted in the organization of our investigations. It soon became evident that the amount of the appropriation was insufficient to secure the thorough prosecution of

either of the two general lines of investigation determined upon. Difficulties were also encountered in securing the services of persons competent to prepare publications or conduct investigations under the temporary arrangements necessitated by the character and limits of the appropriation. The work, therefore, proceeded somewhat slowly at first. Several bulletins were, however, contracted for and two were completed within the fiscal year for which this appropriation was made. A report was also made to Congress on the usefulness of storage reservoirs as a part of the irrigation system. Financial aid was extended to investigations on irrigation at several of the experiment stations and a special apparatus, required for investigations on the duty of water, was devised by Professor Mead.

In the report of the Director of this Office for 1898 the need of the establishment by Congress of some definite policy regarding the irrigation investigations of this Department was strongly urged, the largeness of the task of pursuing thorough investigations was pointed out, and the inadequacy of the appropriation to meet the demands of the work was earnestly insisted upon.

The recommendation that the appropriation for irrigation investigations be increased from \$10,000 to \$50,000 was indorsed by the Secretary of Agriculture, who included this amount in his estimates of the appropriations required for this Department. The movement to extend the investigations of this Department in irrigation also found many friends among the people of the irrigated region. After careful consideration of the matter, Congress decided to increase the appropriation to \$35,000 for the present fiscal year, of which \$10,000 was made immediately available. The terms of the appropriation act were also changed so as to indicate that the decision had been reached to put these investigations upon a basis which promised their continuance as long as they proved successful. Under this act the money is appropriated "to enable the Secretary of Agriculture to investigate and report upon the laws and institutions relating to irrigation and upon the use of irrigation waters, with special suggestions of better methods for the utilization of irrigation waters in agriculture than those in common use, and for the preparation, printing, and illustration of reports and bulletins on irrigation; and the agricultural experiment stations are hereby authorized and directed to cooperate with the Secretary of Agriculture in carrying out said investigations in such manner and to such extent as may be warranted by a due regard to the varying conditions and needs of the respective States and Territories, and as may be mutually agreed upon."

This matter having thus been more satisfactorily provided for, measures were at once taken to organize the work more systematically and on a more permanent basis. It having been decided that the work would be most efficiently prosecuted by having its headquarters in the irrigated region, an office was established at Cheyenne, Wyo. Professor Mead was appointed irrigation expert in charge, and made arrangements to withdraw from his position as State engineer in order to give his time and energies wholly to the work of this Department. The organization of an expert and clerical force was undertaken under the general regulations of the service. With the opening of the irrigation season, a reconnoissance of the irrigated region was begun by Professor Mead with a view to determining the most suitable location for investigations on the duty of water, and for ascertaining what persons were available for this service and other work in

connection with the irrigation investigations in the different States and Territories. Diligent inquiry has, in large measure, served to bring out more clearly the fact that the institution and prosecution of successful and thorough investigations in irrigation in the vast region which these investigations should cover, will be a large and difficult undertaking. The subjects requiring investigation are so numerous, the conditions and needs of different localities are so various, and the demands on the part of people for immediate information in so many lines are so urgent, that much attention will have to be given to the careful selection of the lines of work to be immediately undertaken. One great difficulty is to find an adequate number of men who have had the proper training to fit them to prepare publications or carry on investigations in the manner which our work requires. As a rule, the men who would be best fitted for this work are already engaged in other enterprises and can not be induced to enter the Department service on the terms necessarily imposed. In this, as in other special lines of investigation which the Department has undertaken, it will be necessary to organize a force to work under the immediate direction of the expert in charge, and some time must elapse before this force can be thoroughly trained so as to perform most efficient service. Our efforts have, therefore, been thus far largely directed toward ascertaining who are available candidates for positions in this service. It is well, however, that this difficulty should be distinctly recognized. The need of the hour is for definite and accurate information on irrigation subjects and thorough investigation of irrigation problems. While there is much general information which may be easily obtained, it will not, as a rule, bear close scrutiny, and does not possess that degree of accuracy which alone can make it thoroughly satisfactory.

The agricultural experiment stations in the West have in many places encountered many difficulties in reaching an efficient organization, have had most of their funds absorbed in a variety of investigations regarding the different kinds of crops to be grown in regions recently opened to agriculture, have, as a rule, been connected with colleges having very limited resources, and have received little financial aid from the State governments. In a number of places the stations have made promising beginnings of irrigation investigations, but thus far comparatively little has been actually accomplished, and the number of station officers competent to carry on such investigations in a satisfactory manner is quite limited. As far as practicable this Office has endeavored to utilize the services of station officers, but under present conditions the work of these officers can form only a comparatively small portion of the general enterprise. The boards of management of the stations have, however, been led to see the importance of the work on irrigation which the Department has undertaken and are already moving in the direction of the employment of a larger number of competent investigators who can work in cooperation with this Department. For the stations, as for the Department, there must, however, be a period in which the training of experts and the efficient organization of investigations will be the most important features.

Besides the attention given to questions regarding the organization of a force for these investigations, considerable actual work of investigation has been instituted, the chief features of which are set forth in the following statements which embody the substance of a report recently made to this Office by Professor Mead.

INVESTIGATIONS OF IRRIGATION LAWS AND INSTITUTIONS.

The need of an impartial and thorough study of the subject of water rights and the laws and methods of enforcing them is so urgent that the Department has been under a continuous pressure from the people of the arid States to devote all the funds for irrigation investigations to this branch of the subject. Petitions from three of the leading irrigation States have been filed for an immediate and comprehensive study of their conditions and needs, and the early preparation of a report thereon to be used as a basis for immediate State legislation. Because of this desire for information all of the bulletins thus far published have dealt with this phase of the subject, but the information provided has only increased the desire for additional data.

The immense area embraced in the irrigated region, the wide difference between the laws and methods of the different States, and the complexity and number of problems to be considered, have required the expenditure of a great deal of time and thought in the organization of this investigation. All of the time which could be spared from this work has been given by the expert in charge to a personal study of the situation in the different States and to the selection of localities in which to begin the work. It is the intention, if sufficient provision is made, to include all of the arid and semiarid States in these studies during the ensuing year. There is a double necessity for this. In each of these States laws and methods differ widely. Even where conditions are similar the nature of the titles to the water and the methods of distribution are wholly unlike. Not all of these can work equally well. Some must be better than others. The wider the field of the inquiry the greater the opportunity for comparison and the more valuable the result.

There is a second reason for making this investigation general. Many of the most important rivers of the arid region are interstate streams. Some of them are used for irrigation in a half dozen different States. The water laws of these different States deal with a common supply. They vary so widely in character that there must sooner or later come a time when their differences must be reconciled, or at least be brought to the attention of the federal courts and become a subject of legislation by Congress. It is of the utmost importance that before either of these things occur there should be a thorough understanding of the character of the rights which have vested under these laws, and of the disturbances which will ensue if a uniform or interstate system of water laws should be put in force. It is only through the collection and publication of these facts that either the several States or Congress can intelligently determine whether or not the control of rivers used in irrigation should be left exclusively to the States, as is done at present, or whether the present practice should be overturned and the streams be divided under the operation of federal laws and under the control of federal officials.

DUTY OF WATER.

Measurements of the actual volume of water used in irrigation and the time of such use are being carried on in fifteen States and Territories. The object of these measurements and the methods employed are set forth in schedule 2 of "Instructions to observers," as follows:

An approximate knowledge of the quantity of water required to irrigate an acre of land is sooner or later a necessity in any irrigated district. Farmers, canal builders, water commissioners, lawmakers, and courts all need this information in the making of water contracts, the planning of works, and in the determination and protection of rights in streams. Without it, all these important transactions have to be largely based on conjecture, and the mistakes to which this gives rise are a serious obstacle to the conservation of the water supply and its peaceable and orderly division.

It is the purpose of this investigation to begin the collection of this information, but, in order that it may have general acceptance and value, the facts secured must embrace a wide range of conditions and crops, and be continued through a series of years in order that accidental variations in seasons may be eliminated. Before the investigation is ended, it is expected that it will embrace a study of more economical methods and a determination of the extent to which the reclaimed area can be extended thereby, but at the outset it is desired to ascertain what is the common practice of irrigators. In order to accomplish this, it is desired in the first year's work that, in all cases where measurements are made, crops shall be irrigated whenever water is needed, and all the water which can be beneficially applied shall be used. Care should be taken to prevent waste, but the methods employed should be those in common use, and no special economy or special methods employed. In other words, it is desired that farmers shall irrigate exactly as though no record whatever was being kept.

The method of measurement adopted had to take into account the fact that the demands of crops are not the same during the different seasons of the year, more water being required at some periods than at others. Nor is the supply uniform. Streams rise and fall, increasing or diminishing the quantity to be measured. The adoption of any device for delivering a uniform flow would not, therefore, either meet the demands of users or the character of the supply. What has been done has been to provide for keeping a constant record of the amount used, without any regard to the intentional variations in use or the accidental changes in the supply.

To do this, it has been arranged to measure and record the depth of water passing over a weir or flowing through a flume, and from this record to compute the amount of water used.

The register for recording the amount of water used was designed for this special work by the expert in charge. It has proven satisfactory. The measurements themselves are to determine (1) the general duty of water, or (2) the difference in the time of use and the relative volumes required by different crops.

The first class of measurements embraces determinations of the water used in the irrigation of large areas devoted to different crops. Record is kept of the volume flowing through the main canal, and a measurement of the acres cultivated gives the duty it has performed, including loss in transportation through the main canal and in distribution through the lateral. No distinction is made in these measurements of the requirements of different crops, although the final record will probably show their influence.

Under the second class of measurements losses in distribution are eliminated. Measurements are made at the borders of the field where the water is used, the object being to determine the crops which require large amounts of water and those which do not; also to determine those crops which require to be irrigated during the season when streams are low, and those which can be brought to maturity by irrigation during the flood period. The latter measurements have a special reference to the usefulness and value of storage reservoirs.

The location of the official stations and the names of the observers are as follows:

Official stations and names of observers.

State.	Location.	Observers.
New Jersey	New Brunswick	Prof. E. B. Voorhees, of the New Jersey Experiment Station.
Nebraska ¹	Gothenburg	A. M. Allen.
Montana	Bozeman	Prof. S. Fortier, of the Montana Experiment Station.
Wyoming	Wheatland	M. R. Johnston.
	Laramie	Prof. B. C. Buffum, of the Wyoming Experiment Station.
Colorado	Holly	Thomas Berry.
Texas	Beeville	Prof. S. A. McHenry, of the Texas Experiment Station.
New Mexico ²	Carlsbad	W. M. Reed.
	Mesilla Park	Prof. C. T. Jordan, of the New Mexico Experiment Station.
Arizona	Phoenix	W. H. Code.
California	Riverside	W. Irving.
Utah	Logan	Prof. Geo. L. Swendsen, of the Utah Experiment Station.
Idaho	Salt Lake City	R. C. Gemmel, State engineer.
	Boise	D. W. Ross, State engineer.

¹ The State engineer of Nebraska, J. M. Wilson, is also cooperating with this investigation in the collection of data.

² Records of the duty of water at Aztec and East Las Vegas are also being furnished us by the New Mexico Agricultural Experiment Station.

The establishment of additional stations was prevented by delay in securing apparatus for measuring the variations in discharge, but records are being kept by volunteer observers in cooperation with this investigation in Montana, Washington, and Kansas. Arrangements have also been made for the cooperation of Prof. L. G. Carpenter, of the Colorado experiment station, who has undertaken the preparation of a bulletin embodying some of the results of his important investigations on the duty of water, and will participate in future investigations in that State.

One object of the studies of the duty of water is to secure greater economy in its use, the reclamation of an increased area and larger yield of crops through its more skillful application. In order to accomplish these results something more is necessary than measurement of the quantity employed. The factors which tend to produce a high or low duty must also be studied. These include amount of rainfall, records of temperature, rate of evaporation, the character of the soil, losses in transportation in canals, the merits of the different methods of distributing water over the land, the influence which is exerted by the character of the private water-right contracts for delivering water, or of State laws governing titles thereto.

Before we can rightly estimate the necessity or value of reservoirs we must know not only the amount of water required by different crops but the time when such water is needed. The purpose of reservoirs is to bring the fluctuations in stream flow into harmony with the variation in the demands of crops. A dependence on the natural flow of many Western rivers permits of only a small fraction of their discharge being utilized, because the waters run to waste before or after they are needed. We must know when water is needed and how much is needed in different months of the year before we can rightly estimate how much must be stored in order to utilize the entire supply.

The results already secured render it manifest that the unit now usually prescribed by law or employed in private contracts for the

measurement and delivery of water is indeterminate; that it is not in accord with the needs of water users, and that canal companies can not comply with the requirements of the laws and contracts. Contracts for the delivery of water in either inches or cubic feet per second require the delivery of a uniform, constant flow. Neither the discharge of streams nor the needs of irrigators agree with this, and the result is that we have one system of rights and of distribution in theory, and a wholly different one in actual practice.

It is only by making these facts plain through the demonstration of what actually takes place that the wide discrepancy between the laws governing water rights and the usages of irrigation is made apparent and the importance of bringing them in harmony can be properly appreciated.

The character of water-right contracts has much to do with the economy or waste which prevails in irrigation. Many of these contracts have been prepared by people having little practical knowledge of the subject. Among the classes of contracts which have been productive of either discontent or abuses are—

(1) Perpetual water rights. Under these contracts the user pays a certain amount per acre for all the land under the canal, whether he irrigates it or not. These contracts usually specify a certain duty which has been fixed before the necessities of the land or crops to be cultivated were known. Sometimes this duty is so low as to be a direct incentive to waste, and in others so high as to be manifestly one-sided and unfair.

(2) The second class of contracts are those for the delivery of the water used at a specified rate per acre without any regard to economy or waste of the irrigator. These contracts lead to controversies because of the temptation on the part of the irrigator to use all he can regardless of his necessities, since in that way he gets more for his money, while on the part of the canal owner the temptation is to agree to provide water for as many acres as he can without regard to his ability. These contracts are unfair in making the skillful irrigator pay as much as his more wasteful and negligent neighbor.

The objections to these two classes of contracts are leading to the evolution of a new system in which payment is made for the quantity of water used. Some States have by law required this form of contract, and many companies are adopting it. The reports of the measurements this year indicate that a contract which makes it to the interest of the irrigator to economize, in many cases results in double the duty of water obtained under similar conditions under the first two forms of contract described.

MISCELLANEOUS INVESTIGATIONS.

In addition to the investigations before referred to there will soon be published a bulletin dealing with the irrigation problems of Montana and the State laws for the building of canals to be operated under State control; also a bulletin describing the methods of irrigation used in fruit growing on the Pacific coast, and bulletins descriptive of methods of distributing water in irrigation, of the different forms of water-right contracts in use by canal companies, of the fertilizing value of sediment carried by streams, and of the beneficial or injurious properties of the soluble salts carried in the water of Western rivers and the progressive increase of these salts in the lower portions of streams due to the action of seepage.

INVESTIGATIONS IN THE HUMID REGION.

The usefulness of this investigation is not limited to the arid region. On the contrary, there is no question that irrigation can be profitably employed in the cultivation of large areas in both the Eastern and Southern States. There are now over 100,000 acres of sugar land being irrigated in Louisiana alone, and the area is being constantly extended. The irrigated rice fields of the Carolinas produce a product unequaled elsewhere in quality, and wherever natural conditions will permit of its aid there is no agency which will do more to increase the yield or insure the quality of crops than the application of moisture when needed. There is a wide field for the employment of irrigation in the East and South in market gardening, in the irrigation of alfalfa and of pastures, in the cultivation of high-priced products, and in the utilization of the sewage of cities and towns. It is believed that it will be wise economy for the General Government to promote the construction by private enterprise of small irrigation works on Eastern and Southern farms by supplying free of cost plans for ditches and advice and instruction regarding the methods of distributing and applying water.

A beginning of irrigation investigations in the humid region has already been made. Prof. E. B. Voorhees, of the New Jersey Agricultural Experiment Station, is now collecting data showing the area of land irrigated in that State, the methods employed, the duty of water obtained, and the benefits received.

IRRIGATION PUBLICATIONS.

Two bulletins on the laws and rights pertaining to irrigation waters have been issued from this Office during the past year, and a third bulletin is in press.

Water Rights on the Missouri River and its Tributaries (Bulletin No. 58), by Elwood Mead, State engineer of Wyoming, J. E. Field, State engineer of Colorado, and J. M. Wilson, State engineer of Nebraska, contains a discussion of the laws which control the diversion and use of waters of the Missouri River and its tributaries.

Abstract of Laws for Acquiring Titles to Water from the Missouri River and its Tributaries, with the Legal Forms in Use (Bulletin No. 60), compiled by Elwood Mead, State engineer of Wyoming, is supplementary to Bulletin No. 58 of this Office (see above), and with it forms a manual of instruction regarding the methods of procedure in acquiring water rights in the Missouri River watershed.

Water-right Problems of Bear River (Bulletin No. 70), by Clarence T. Johnston and Joseph A. Breckons, deals with the water supply of Bear River and its diversion, and discusses interstate water rights in that river. This river was chosen for study because in its course of a little over 300 miles it crosses State lines (Wyoming, Idaho, and Utah) five times, finally emptying into Salt Lake, which is less than 50 miles from its source, thus presenting in small compass a great variety of interstate problems and offering exceptional opportunities for the inauguration of this class of inquiries.

A report on the usefulness of reservoirs to agriculture in the irrigated regions, prepared by Prof. Elwood Mead, was made by the Secretary of Agriculture in response to a resolution of the Senate, and was published as Senate Doc. No. 124, Fifty-fifth Congress, third session.

EXTENSION OF INVESTIGATIONS.

The general lines of investigation having been established and the organization of the force for the prosecution having been arranged for, it will be possible during the coming year to materially extend the investigations already begun, and, if adequate means are provided, to enlarge the scope of these investigations. A large amount of data will be collected showing how water is owned, distributed, and used on the streams where irrigation has reached its greatest importance as a necessary adjunct to agriculture. On its legal side, this inquiry should be extended to show quite fully the nature and extent of the claims to water on representative streams and their tributaries, the manner in which rights to water are established under State laws, the nature of litigation over these rights in the courts, and the forms of private contracts for furnishing water to users. A comparative study should also be made of the laws, customs, and methods of the irrigated regions of both Europe and Asia in relation to those of the arid regions of this country, in order that our people may have the benefit of the lessons which experience in the old world has taught. Economic questions should also receive attention, including the collection of facts as to the areas irrigated for different crops, the value of the products, and the means by which the irrigated areas can be extended or rendered more productive.

In connection with the investigations on the duty of water, there should be measurements of the capacity of canals and ditches for diverting water, the losses of water in transportation and the gains from seepage, and the amount and influence of sediment contained in irrigation waters.

The investigations in New Jersey should be continued and studies should be made of irrigation as applied to the culture of rice and sugar cane.

One of the largest problems in the irrigated region of this country relates to the proper utilization of vast areas of grazing land adjoining lands which have been, or may be, profitably used for agriculture under irrigation. In many sections of the West the profits of irrigated farming depend entirely on the ability to control or use the surrounding grazing lands. The value of much of this grazing land can be very greatly increased by uniting its use with that of the irrigable land and by such measures as the enactment of laws to promote the construction of small reservoirs or wells for the convenience of watering stock. Those problems which relate to the union of irrigation farming with grazing may properly be included in the irrigation investigations of the Department, and it is believed that a study of questions relating to the grazing lands would form an important feature of investigations which should be undertaken by various agencies with reference to the settlement of the great questions involved in the wise and economic utilization of the arid public lands, which are so situated that they can never be used for agricultural purposes other than the grazing of live stock.

In the organization of the irrigation investigations in this Office, the fact is clearly recognized that only a small portion of the problems connected with the successful prosecution of agriculture in the irrigated region will properly come within the scope of these investigations. At many points they will necessarily touch upon matters connected with investigations which properly belong to other branches

of the Government and especially of this Department. It is much to be desired that some plan of cooperation should be arranged which will prevent unnecessary duplication of work, and it is hoped that this may be reached in the near future.

IMPORTANCE OF IRRIGATION INVESTIGATIONS.

Irrigated agriculture in the United States has ceased to be either an experiment or to have merely a local importance. More than one-third of this country depends on the success of irrigation to maintain the people, the industries, and the political institutions of that area, and future growth will also be measured by the increase of the reclaimed area. In a region, which, in the extent and diversity of its mineral wealth has no equal on the globe, the riches of the mines in the hills are already surpassed by the products of the irrigated farms of the valleys, and the nation at large is at last awakening to the fact that the development of the use of the rivers and arid lands of the West will constitute one of the most important epochs in our increase in population and material wealth.

In order to maintain the homes, the factories, and the people which now occupy that section, the success of the irrigated farm must be made certain. Without the lessened cost and increased comfort of living which comes from a local food supply, which irrigation alone has made possible, many mines now idle can never be worked and many now productive must be closed. It is only through this that the marvelous attractions of this region for health and pleasure seekers have been made available and its great resources in other directions utilized. The irrigated lands which surround Denver, Salt Lake City, and scores of other cities are more than a pleasing relief from the aridity which they have displaced. They are the builders of those cities.

Nor are the benefits of irrigation restricted to the section of scanty rainfall. On the contrary, it is an important element in promoting our national prosperity. It furnishes the greater part of our exports of mutton and beef, and cheapens the cost of the coat and adds to the abundance of the breakfast of the wage-earners in every Eastern city.

The arid region has been, and will always continue to be, the most favored section of the United States for the production of meat and wool. We can not have too much of either of these. But without the irrigated farm the raising of range cattle and sheep would soon be only a memory. It is only through irrigation that winter feeding is made possible, and without the products of the land now irrigated half of the range flocks and herds would have perished during the storms of the past winter.

The practical question now before this Government is, What is its duty and responsibility? What should be done to protect the acres now watered and secure the largest increase in their number? That there is a national responsibility is shown by the fact that every other civilized country where irrigation is practiced has recognized this duty. The British Government has expended nearly half a billion dollars on irrigation works in India, and has just begun the construction of an irrigation dam to cost \$24,000,000 in Egypt. Italy spent over \$17,000,000 on a State canal to water a plain where the annual rainfall is equal to that of the Mississippi Valley. Canada

has made irrigation a matter of national aid and provides the same safeguards for recording and protecting titles to water as are thrown around the disposal of the land it renders productive.

That there is urgent need of effective and adequate legislation by Congress is the conclusion of every student of the subject. Over a quarter of a century ago our minister to Italy, after an exhaustive study of irrigation in Europe, prepared an able report thereon for the Commissioner of Agriculture, in which he gave the following as among the things which legislation should provide for the promotion of irrigated agriculture (Report of the Commissioner of Agriculture, 1874):

That either the nation or the States should—

“See that private individuals or associations do not acquire title by hasty grant or prescriptive rights, by appropriating to their own exclusive use the scanty supply (of water) which nature designed for the common benefit of all.”

Assume absolute ownership of all waters.

Provide for hydrographical survey.

Construct canals and reservoirs.

Prohibit the destruction of forests.

Regulate use of water so as not to injure lower lands.

Provide mode of withdrawal of water and method of measurement.

Prescribe rates for water.

Provide tribunals with power to assign to individuals the volume of water and time of its use.

Provide for right of way for canals to irrigate lands not contiguous to main canals.

Provide “a series of brief reports of experiments deliberately made by persons of known competence, *under Government patronage*.¹

* * * Such experiments would embrace the investigation of the best methods and seasons of administering water to different crops, *and of the quantities required for each*;¹ the increase in the quantity of the product from irrigation, as ascertained by actual comparison with similar crops grown without water.”

The investigations of the Department now being carried on are so closely in accord with the above conclusions as to show that the experience of other lands does not differ widely from our own.

Every step in the growth of irrigation in this country has illustrated the wisdom of these recommendations and made the need of such action more imperative. We have reached a point where the best use of our resources and the protection of investments already made require that the haphazard location of ditches must cease. Building new ditches above to take water away from farms already irrigated below is not growth; it is destruction. Lavish grants of water to speculative appropriators for the “purposes of rental or sale,” for which the irrigation laws of many States provide, does not promote the success of water users, but it does too often make them the victims of the greed or ignorance of the holders of these grants. As a result of loosely drawn and imperfect laws for acquiring titles to water, all the rivers of the continent would not supply the water-right claims which are found in the official records of the arid States. The pretended establishment of rights to more water than a river carries or is actually used does not aid the irrigator; on the contrary, it is his most serious menace, since there can be no stability in irrigation nor freedom from controversy among irrigators so long as such

¹ The *italics* are ours.

excessive claims exist. Yet, this condition now prevails on a majority of the rivers most used in irrigation. Every owner of an irrigated farm, and every man who expects to be an owner, needs to know exactly the nature of his right in the stream on which his success depends. This is not possible at present. Thus far the nation has made no provision for the distribution of either the natural flow of streams or of stored water, and in only three of the seventeen arid or semiarid States are the rights of appropriators protected by public officials, or are any provisions made for enforcing economy in the use of water. If the control of this element of production is to be left to the States, there should be a definite declaration to that effect. If it is to be assumed by the General Government at all, it should be done at once. The present uncertainty is both unwise and unfair. We can not go on as we are now doing, fighting for titles to water in the courts and perpetuating a condition of chaos and uncertainty which each additional farm reclaimed only serves to increase.

Along many streams more farms have been brought under cultivation than can be irrigated from the natural flow. Every year there is a season of shortage in which some canals are empty, and in a few days' drought the irrigator loses the fruits of his year's labor. The remedy for this is the storage of floods. The demand for storage reservoirs is based on a necessity which is already widely felt and which must increase. Their construction will supply the demand of lands now under cultivation, and in many cases increase the area from three to five fold. Before they are built it ought to be determined who owns the streams from which they will be supplied, and how the water is to be distributed, that it may benefit the irrigator rather than the speculator. There is neither wisdom nor justice in the building of reservoirs on the head of a stream when there is no provision for the right distribution of the commodity they are to impound.

These are only a few of the many problems which confront those dependent upon the success of irrigation or interested in its extension. On their right solution depends not only the right use of our resources, but the social well-being of millions of people. In order to accomplish this we must have more definite information of what has already been done, the rights which have been acquired, and the methods now being pursued. It was to obtain this information that the investigation of irrigation problems now being carried on was inaugurated by Congress. It came in response to a growing unrest due to the present chaotic conditions, and a desire that the laws and social institutions which go with irrigation should be made more uniform and stable, and the disastrous controversies and costly litigation over water rights be brought to an end.

RECOMMENDATION.

With a firm belief in the desirability and practicability of extending the irrigation investigations of this Office in the near future along the general lines on which they are now organized, I renew the recommendation made in my previous report, that the appropriation for these investigations be increased to \$50,000.



REPORT OF THE DIRECTOR OF THE OFFICE OF PUBLIC ROAD INQUIRIES.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF PUBLIC ROAD INQUIRIES,
Washington, D. C., August 31, 1899.

SIR: I have the honor to submit herewith the report of the Office of Public Road Inquiries for the fiscal year ending June 30, 1899, together with an outline of the work for the current year and estimates for the ensuing year. On account of my absence from the Office during part of the year, that portion of the report covering the past year's work was prepared at my request by my assistant, M. O. Eldridge.

Respectfully,

ROY STONE,
Director.

Hon. JAMES WILSON, *Secretary.*

WORK OF THE YEAR.

The work of the Office during the past year has been marked by a steady progress along its well-established lines. The small office force has been kept busy prosecuting inquiries, answering correspondence, and gathering and disseminating important information relating to the various phases of the road subject. Many thousand copies of good road literature have been distributed among farmers and other persons interested, and important road conventions have been attended by representatives of the Office where information regarding the ways and means of road improvement have been both collected and distributed. Many State legislatures have asked for and received our assistance in framing new road legislation. Farmers' organizations, farmers' institutes, business organizations, schools, colleges, etc., have petitioned for our cooperation and advice, and many of them have been accommodated. The progress of road construction has been closely watched and the field operations have been vigorously prosecuted. The value of the object-lesson methods adopted by the Office have become so clear that there is a general and very urgent demand for their continuance and extension. This work has been pushed forward as rapidly as the time and means at hand would permit, but in order to have complied with all the demands for assistance along these lines our force and means should have been at least ten times larger.

LITERATURE.

The spirit of inquiry on all road matters among agriculturists and road reformers is steadily increasing, and requests for information

covering a wide range of subjects have been more numerous than ever before. In view of the wide interest attaching to the subject and of the fact that many of the previous publications of the Office were not available for free distribution, Farmers' Bulletin No. 95, entitled "Good roads for farmers," was prepared at your direction by Assistant Director M. O. Eldridge. In preparing this bulletin the object sought was to present in the plainest possible manner the fundamental principles of road construction and maintenance and at the same time to make, if possible, an instructive compendium of road literature. Thousands of copies of this bulletin have been asked for and distributed; many persons have been supplied who had not before heard of the Office of Public Road Inquiries, and numerous testimonials regarding the usefulness of the Office and its work for the farmer have been received. This exemplifies the statement which has been previously made in reports from this Office, that the most practical road inquiry bulletins should be placed on the same footing as Farmers' Bulletins. "They are not calculated to be of private advantage to anybody, but are to be used solely in educational work. Few people can be expected to buy them for that purpose, while many would take the trouble to use them if they could be had free of cost."

"Must the farmers pay for good roads?" is perhaps one of the most popular little pamphlets ever published on the road subject. It was written by Mr. Otto Dorner, of Milwaukee, Wis., chairman of the national committee for highway improvement of the League of American Wheelmen. It was published by that league and adopted as Circular No. 31 of this Office, and hundreds of thousands of copies have been distributed throughout the country. Mr. Dorner's idea is, briefly, that since the city and suburban population enjoy the benefit of good roads equally with their country neighbors, the farmers, the labor and expense of building good roads should be in no wise imposed solely upon the farmers, who can not afford it, but that the burden should be shared by city and village taxpayer, or in fact by every citizen of the State and nation. As the bad condition of the country roads affects the town to which the county is tributary as well as the country itself, it would seem that Mr. Dorner favors a happy solution of a most perplexing problem, as well as a measure of justice to all parties concerned.

"State aid to road building in Minnesota," by A. B. Choate, was published as Circular No. 32. Mr. Choate's scheme of legislation is quite similar to that advocated by Mr. Dorner, in Circular No. 31, and his idea is, in short, that the present system is a great injustice to farmers, that a large proportion of taxable property is in the cities and towns, and that "State aid" means equal taxation.

The governors of a number of States recently in their messages to the several legislatures called attention to the great importance of better highways. These messages have been collected and extracts relating to road improvement have been prepared and printed as Circular No. 33. These extracts indicate the present condition of legislation as to roads, and give some idea of public sentiment in the States where they were prepared. Governor Mount, of Indiana, touches the keynote which should be sounded throughout the land until every public road shall have been improved, when he says that "the farmer whose family is held in the thralldom of mud for a large part of the year is subjected to the ordeal that trammels progress, fetters social growth, and retards intellectual development."

The arguments made by many of the other governors to the legislatures are no less impressive than that made by Governor Mount, and all of them are equally convincing.

STEEL ROADS.

Hon. Martin Dodge, of Cleveland, Ohio, filled the position of Director from August, 1898, to January, 1899, General Stone being on leave and serving on General Miles's staff as a brigadier-general in the war with Spain. During Mr. Dodge's incumbency plans were completed and carried out for samples of steel-track roads in short sections at Omaha, Nebr., Ames, Iowa, and St. Anthony Park, Minn. These experimental sections of steel road clearly demonstrated their usefulness for the Western States and for the other level States which are but sparingly supplied with good stone or gravel. The time was so limited and the means at our disposal so inadequate that we had to prepare a design for these steel roads, using rails of the regular shapes found in the market. Imperfections were naturally found which can be easily remedied if steel again becomes so cheap that the manufacturers can take the matter up and make rails of special shapes, or if sufficient means are appropriated by Congress to perfect the system.

ROAD GATHERINGS AND ORGANIZATIONS.

The National Road Parliament was held under the auspices of this Office in connection with the Trans-Mississippi Exposition at Omaha, Nebr., October 10, 1898. Although not a large gathering, it was a very successful one. Most of the Western States were represented, something which had not heretofore occurred in meetings of this sort, and the delegates who attended were the representative and enthusiastic road workers of their respective communities and States. A large number of local meetings and State conventions have been held and road leagues have been formed in many progressive communities, and it is believed that much good has been and will be accomplished by "agitation, organization, and education," which are the best means of securing wholesome and effective results. The State and Interstate Good Roads and Public Improvement Association, of which Mr. W. H. Moore, of St. Louis, is president, is holding good-roads conventions in many of the wide-awake and prosperous cities of the middle Western States. The people of that section are more thoroughly aroused over this question than ever before; they are waging an effective campaign for the betterment of their highways, and Mr. Moore says there will be no "let up" in this great educational movement until such laws are enacted as will insure better highways throughout the West.

OBJECT-LESSON ROADS.

The object-lesson road work of the year has been as extensive in territory covered as it has been far-reaching in results accomplished. Model roads of various kinds have been built under the supervision of Mr. E. G. Harrison, special agent and road expert, in the States of Maryland, Nebraska, Minnesota, Iowa, Kentucky, Indiana, and Wisconsin.

One of the Maryland roads was built from Fork to Kingsville in Baltimore County. The macadam method was adopted and trap

(igneous) rock was used in the construction. The stone was crushed with a Champion crusher and separated into the proper sizes with a revolving screen, the various sizes were spread on the prepared earth foundation in layers with a Champion distributing cart, and each layer thoroughly rolled and consolidated with a steam roller. On July 30, 1898, a large number of people, including many State and county officials, assembled to witness the construction. The severe weather of last winter had little or no effect upon this road, and it is now almost as smooth and hard as asphalt, while other roads in the county, which were built with the same machinery and of the same kind of stone, are rough and uneven, and in some places covered with loose stones of various sizes. A section of common earth road was improved in Harford County, near Fulsom, by simply underdraining the road with tile drains. A sample stone road was also built in Harford County out of the ordinary surface bowlders or field stone. They were crushed, separated into suitable sizes, spread on in layers with the larger sizes on the bottom, sprinkled, and rolled until compact and smooth. Screenings and stone dust were used as a binder or filler as well as for the top layer, thus leaving the surface ready for immediate use.

A State good roads convention was held at St. Anthony Park, Minn., under the auspices of the experiment station and university of that State, and during this convention students of the State University and other people interested were taught by our expert how to build a macadam road. The trap rock used in the construction was from Taylors Falls and was furnished free of charge by the St. Paul and Duluth Railroad Company. As a direct result of this sample road work the officials of the city of St. Paul and Ramsey County let the contract at once for the construction of 2 miles of road modeled after the one built by our expert on the State fair grounds and surfaced with trap rock from Taylors Falls. After laying 280 feet of steel track on the grounds of the Trans-Mississippi Exposition at Omaha, Mr. Harrison returned to St. Anthony Park, Minn., and placed on the State experiment station grounds a sample of steel track of the same length; 280 feet were also placed on the grounds of the State College at Ames, Iowa. The construction of these roads is treated of in the Yearbook of the Department for 1898, under the title "Steel-track wagon roads," by Martin Dodge.

During the month of February the engineering students of the University of Louisiana at Baton Rouge were instructed in the art of building earth roads. Owing to the absence of stone, gravel, or other road-building materials, and to the fact that this experiment involved the application of new principles of construction to many who viewed the work, a wide interest was manifested. After having lectured before the farmers' institutes in Kentucky for about a month, Expert Harrison began the construction of an object-lesson road on the grounds of the University of Kentucky at Lexington. A State day was held and was largely attended by representative men from all parts of the State. There is, perhaps, no part of the country which is so much in need of better roads as the South, and it is to be hoped that the experimental section of stone road built in Kentucky will do something toward transforming the roads of that part of the country from boggy and dusty lanes into scientifically constructed highways.

Through the generosity of Hon. J. H. Stout, and with the cooperation of the railroad and road-machine companies a half-mile section

of road was built at Menomonie, Wis. This road was constructed so as to fully illustrate the best permanent highways built out of the best and most lasting materials, also the feasibility of utilizing such materials as localities have at hand. One section was built of gravel over a sand foundation, another of stone over a gravel foundation, while another was built with a gravel-wearing surface and a stone foundation, and still another illustrated the regular macadam construction. As a test of the latest proposal for road improvement, an earth road was rounded up, sprinkled with crude oil, and thoroughly rolled.

State day was well attended, and it is believed by many who were present that this experimental section of road will be of incalculable value to Wisconsin, and finally, when results are made known, to the whole country.

ROAD INQUIRIES.

The principal inquiries made during the year were upon the following subjects: New road legislation, and especially that for State aid; the use of convict labor in road building or in the preparation of road materials; experiments in steel roads and other new plans; methods of raising road funds; bond issues and rates of interest paid; condition of new roads under wear, especially of the sample roads supervised by this Office; the promoting of rural free delivery of mails by good roads; the progress of organization for road improvement; the prospects of road construction during the year, etc. Numerous responses were received from many of the best workers for road improvement, and the subjects were most interestingly and intelligently treated, so much so in fact, that many of them are being prepared as a circular or bulletin of the Office.

The consensus of opinion in this correspondence is that "State aid" is the best law under which to build and maintain roads. The method of working convicts in quarries and gravel pits in preparing road material is earnestly supported by everyone, and the use of convicts in actually building roads is strongly advocated by many people, especially those from the South. As a result of road improvement, the appreciation in land values has been in most cases marvelous. One instance is given where land was bought for \$12.50 per acre, and only a few years later, when good roads had been built, was sold for \$100 per acre. Many other instances are given where the increase has been from 30 to 50 per cent. So far as we are able to judge from these reports, there is not a community in the United States where good roads have been built that would return to the old "hog in the mud" method. The general opinion is that the free rural delivery of mails should be extended to those communities where the roads are so good that they will be firm and smooth during all seasons of the year. Good progress is reported regarding organization for road improvement. Hundreds of local road leagues have been formed and many States have been thoroughly organized, all of which will result in spreading the good-roads work and in strengthening the movement. The prospects for new road work for the present year are brighter than ever before, and some of the road-machine companies have more orders for machines than they can fill for many months.

As a result of these investigations we are firmly convinced that for local needs as well as for our material development and prosperity, a well-regulated system of public roads throughout the whole country is

day by day becoming more necessary. While we have the most perfect railway system in the world, our public highways are and always have been inferior to those of any other country in the civilized world. As our public roads are the veins and arteries of our agricultural, commercial, and social life, they are not yet receiving the consideration that their great importance deserves. Much has been done in the United States toward road building during the last few years, but much more needs to be done; indeed the beginning has just been made.

PLANS FOR 1900 AND ESTIMATES FOR 1901.

It is the intention, during the ensuing year, to continue and enlarge the scope of the work already accomplished. The miscellaneous work of the Office, as well as the field operations, have increased more rapidly than our facilities. We have accomplished what we have done only by the cooperation and volunteer aid of the road-building machine companies in loaning machinery, and of the railroads in the matter of transportation, both of machines and persons. The road-building companies, while still anxious to cooperate, are all short of machines, and will be less able next season to loan us a supply, while we have, perhaps, overtaxed the patience and courtesy of the railroad companies.

We have made only a small beginning in the progress of work designed to be done at the colleges and experiment stations, and we have been obliged to forego numerous opportunities to take charge of construction of sample roads in other localities where practically all the expense, except our supervision, was guarantied. Under these circumstances there would be practically no limit to the amount of money which could be profitably expended in this matter, but it is better to advance it moderately, and I therefore recommend an appropriation of \$20,000 for the coming year, of which \$5,000 should be made immediately available. This will enable us to put several additional experts in the field immediately upon the passage of the act.

REPORT OF THE EDITOR, DIVISION OF PUBLICATIONS.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF PUBLICATIONS,
Washington, D. C., August 9, 1899.

SIR: I have the honor to submit herewith for your information and consideration a report on the work of this Division for the fiscal year ended June 30, 1899, also recommendations in regard to future operations.

Respectfully,

GEO. WM. HILL,
Editor and Chief.

Hon. JAMES WILSON, *Secretary.*

WORK OF THE YEAR.

ORGANIZATION OF DIVISION.

The Division of Publications as at present organized consists of (1) a main office; (2) a document section, including an office force and a large number of laborers; and, (3) an illustration section.

In addition to the Editor of the Department, who is also chief of the Division, and his first assistant, the main office includes a clerical force and an editorial corps. The clerical force consists of a stenographer and typewriter, a bookkeeper and requisition clerk, a mail and order clerk, and a messenger.

In the illustration section are three artists, one engraver, a clerk, and a laborer. A great part of the illustration work is prepared in the several divisions by artists attached to the divisional forces, some of them being specially qualified by scientific attainments for satisfactory performance of the line of work assigned to them. Of artists so attached to the several divisions, there are no less than six, whose work, when ready for use in a publication, is turned over to this Division.

The distribution of documents is under the immediate charge of an officer designated as assistant in charge of the document section. He has under his supervision an office force, consisting of a stenographer and typewriter and several bookkeepers and order clerks, besides a large body of laborers, numbering, according to the season of the year and the amount of work to be done, from 60 to 75 persons.

The average number of persons employed in the Division during the year, including editorial corps and office force, artists, and laborers, was 107. This report will show in what manner this large force has been employed during the year, what work has been done, and what remains still to be undertaken in order to enable the Division of Publications to fill the place assigned to it in the economy of the Department.

GROWTH OF THE WORK.

The total number of publications issued by the Department during the fiscal year amounted to 603, as compared with 501 the year previous. Of these, 114 were issued by the Weather Bureau, 106 being

printed there. No further account is taken of the Weather Bureau publications in this report, except to include them in the Appendix. This Division exercises no supervision, editorial or otherwise, over the publications of the Weather Bureau, which has its own division of publications and its own editor. The number of publications, therefore, which actually passed through the editorial room was 489, of which 191 were new, and contained 12,864 printed pages, or 2,236 pages more than the previous year. The remaining 298 publications were reprints, necessitated by the urgent demand for them, and included 11,943 pages. Of these reprints, 154 were Farmers' Bulletins.

PUBLICATION WORK IN DETAIL.

The classes of publications issued during the past year, with the funds to which they are chargeable, and the total number of copies of all publications printed during the fiscal years 1893-1899, inclusive, are for convenience presented as follows:

Number and classes of publications, fiscal year 1899.

Publications:

Chargeable to regular fund	341
Chargeable to divisional fund	3
Chargeable to Farmers' Bulletin fund	141
Printed as Executive documents	12
Printed at Weather Bureau	106
Total	603

Number of publications issued from 1893 to 1899.

Year.	Publications.	Total number copies.
1893	210	2,689,084
1894	205	3,169,310
1895	254	4,100,660
1896	376	6,361,700
1897	424	6,541,210
1898	501	6,280,365
1899	603	7,075,975
Total	2,573	36,418,304

The above table presents a very graphic illustration of the steady growth in the publication work in the past seven years, a growth which would be made still more striking were the comparison to be carried back to 1889, the year that this Division was organized. This growth is a fair reflection of the growth of the Department, representing just what has been done toward fulfilling that part of the organic law creating the Department, which makes it an essential part of its duty to diffuse information on subjects connected with agriculture. It is obvious that the addition of any new division or office or even of any new line of work to the duties of any division necessarily means an addition to the work of this Division, as the channel through which all results of any work done in the Department must reach the public. The work undertaken in the Division of Publications does not in any way depend upon nor can it in any way be regulated by the chief. While the work of other divisions is practically controllable and the work undertaken in each is in accordance with a plan laid down by its chief and approved by the Secretary, the work of this Division is simply the result of all these divisional plans, and it must be efficiently performed or some other branch of the Department work must suffer.

Any curtailment from lack of time or money of the work of this Division simply means that valuable information which it has cost much time and money to acquire can not be imparted to the agriculturist until too late to be available to him for the year's work, and its utilization and practical effect is thus postponed for a twelvemonth.

NUMBER OF PUBLICATIONS, BY BUREAUS, DIVISIONS, AND OFFICES.

The part of the several Bureaus, Divisions, and Offices in making up the sum of the publication work for the year is shown in the following table giving the total number of publications contributed by each, originals and reprints, the number of pages, and the total number of copies:

Number of publications, originals and reprints, and pages, by Bureaus, Divisions, and Offices.¹

Bureaus, Divisions, and Offices.	Publications.			Pages.			Number of copies.		
	Orig- inal.	Re- print.	To- tal.	Orig- inal.	Re- print.	Total.	Original.	Reprint.	Total.
Secretary's Office	4	10	14	161	195	356	42,500	54,000	96,500
Executive Documents	12	-----	12	2,946	-----	2,946	681,338	-----	681,338
Accounts and Disburse- ments	1	1	2	45	16	61	3,250	-----	3,250
Agrostology	20	19	39	1,212	389	1,601	106,700	137,500	244,200
Animal Industry	7	31	38	141	754	895	36,500	405,300	441,800
Biological Survey	4	14	18	226	559	785	17,000	52,800	69,800
Botany	6	15	21	742	351	1,093	66,000	62,500	128,500
Chemistry	11	12	23	844	567	1,411	69,500	31,700	101,200
Entomology	17	22	39	698	553	1,251	96,500	152,700	249,200
Experiment Stations	38	86	124	3,081	6,012	9,093	322,500	877,900	1,200,400
Fiber Investigations	2	3	5	109	457	566	8,000	12,000	20,000
Foreign Markets	8	10	18	552	343	895	81,000	29,500	110,500
Forestry	7	8	15	389	343	732	44,500	47,700	92,200
Gardens and Grounds	-----	2	2	-----	32	32	-----	1,500	1,500
Library	5	-----	5	177	-----	177	5,000	-----	5,000
Pomology	1	5	6	58	175	233	10,000	10,000	20,000
Publications	21	4	25	910	77	987	479,500	20,700	500,200
Public Road Inquiries	4	17	21	113	195	308	450,000	108,500	558,500
Soils	6	13	19	168	245	413	78,000	101,400	179,400
Statistics	14	10	24	273	345	618	1,466,500	61,200	1,527,700
Vegetable Physiology and Pathology	3	16	19	20	335	355	35,000	107,400	142,400
Weather Bureau	106	8	114	1,230	382	1,612	698,387	4,000	702,387
Total	297	306	603	14,095	12,325	26,420	4,797,675	2,278,300	7,075,975

¹ Farmers' Bulletins are included in the Bureaus, Divisions, and Offices contributing them.

INCREASE IN PUBLICATIONS.

It will be seen that the total number of copies of all publications greatly exceeds that of any former year. The publications of the Weather Bureau are distributed by one of the employees of that Bureau, reporting, by your order of March 29, 1897,¹ to the chief of this Division. With this exception, and excluding the Executive documents, only a small number of copies of which are distributed through this Department, all of the publications are handled and distributed by the force of the document section of this Division.

¹ UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., March 29, 1897.

MR. WILLIS L. MOORE,
Chief of Weather Bureau.

SIR: In accordance with section 92 of the act providing for the public printing, binding, and distribution of public documents, Mr. C. J. Jones is designated, on the recommendation of the chief of the Weather Bureau, to supervise the distribution of Weather Bureau publications; to keep an account in detail thereof and report the same quarterly to the chief of the Division of Publications.

JAMES WILSON, Secretary.

EXPENDITURES FROM SPECIAL FUND OF THE DIVISION.

The following shows the total expenditures during the year from the special appropriation for this Division, including the amounts for preparation and printing of Farmers' Bulletins, for artists and preparation of illustrations, for artists' supplies, and for labor and materials in distribution of documents:

Pay of artists and preparation of illustrations	\$3,220.00
Labor in distribution of documents	22,361.87
Materials for document section	4,135.02
Artists' supplies	119.66
Total	29,836.55
Preparation of Farmers' Bulletins	4,979.58
Printing of Farmers' Bulletins	29,957.49
Total	34,937.07
Grand total	64,773.62

EXPENDITURES FOR PRINTING AND BINDING.

NUMBER AND COST OF PUBLICATIONS PRINTED BY GOVERNMENT PRINTING OFFICE.

In the following table are given the total number and cost of publications of all kinds printed by the Government Printing Office during the year:

Number and cost of publications printed by Government Printing Office.

Bureaus, Divisions, and Offices.	Publications.				Cost.
	Farmers' Bulletins.	Printed in branch office. ¹	Other.	Total.	
Secretary's Office	8		6	14	\$2,477.64
Executive Documents			12	12	
Accounts and Disbursements			2	2	341.84
Agrostology	10	11	18	39	6,453.55
Animal Industry	21	10	7	38	6,847.95
Biological Survey	3		15	18	3,201.56
Botany	6	5	12	23	2,747.75
Chemistry	6	1	16	23	5,937.28
Entomology	12	13	14	39	5,492.55
Experiment Stations	79	2	43	124	29,579.28
Fiber Investigations	1		4	5	697.32
Foreign Markets		2	16	18	4,842.61
Forestry	2		12	15	4,331.98
Gardens and Grounds	1		1	2	55.86
Library			5	5	908.20
Pomology		1	5	6	962.74
Publications	4	15	6	25	2,746.89
Public Road Inquiries	1	9	11	21	1,340.78
Soils	12		7	19	3,130.28
Statistics		4	20	24	8,104.11
Vegetable Physiology and Pathology	10	2	7	19	1,806.27
Weather Bureau			8	8	260.35
Total	176	74	247	497	91,966.59
Printed at Weather Bureau				106	
Grand total				603	

¹ Seventy-four publications not included.

Recapitulation.

General publications (247)	\$55,297.51
Farmers' Bulletin (176):	
Paid from Farmers' Bulletin fund	29,957.49
Paid from general fund	6,611.59
Total	91,966.59

TOTAL EXPENDITURES FOR PRINTING AND BINDING.

The total cost of all printing and binding delivered to this Department from July 1, 1898, to June 30, 1899, inclusive, was \$128,591.52, as shown by the following statement:

Divisional publications, paid from general fund.....	\$54,681.79
Divisional publications, paid from special funds.....	715.72
Farmers' Bulletins	36,569.08
Blank books, blanks, etc.....	19,509.93
Branch office (all work)	17,115.00
Total.....	128,591.52

EXPENDITURES FOR PRINTING AND BINDING, BY FUNDS.

The following statement shows the expenditures for printing and binding from the several funds:

General printing fund:	
Expended for various divisions	\$74,191.72
Expended for branch printing office.....	17,115.00
Expended for Farmers' Bulletins.....	6,611.59
	\$97,918.31
Farmers' Bulletin fund	29,957.49
Divisional funds:	
Bureau of Animal Industry.....	\$567.79
Biological Survey	147.93
	715.72
Total.....	128,591.52

FARMERS' BULLETINS.

The total amount paid for printing Farmers' Bulletins was \$36,569.08, of which \$29,957.49 was from the fund for preparation and printing of Farmers' Bulletins, and the remainder, \$6,611.59, was defrayed from the general printing fund. The very large number of these bulletins used in satisfying the demands of Department correspondents made this necessary in order not to infringe on the two-thirds reserved by law for the use of Senators, Representatives, and Delegates.

The total number of copies of Farmers' Bulletins printed was 2,437,000, and as the Congressional orders have for the first time in several years fallen below the quota set aside for them, a considerable reserve remained over at the close of the fiscal year, which by law reverts to the Secretary of Agriculture, to be disposed of as the law directs, either for miscellaneous distribution or for satisfying further Congressional demands. This will permit, if you so desire to use this reserve, of increasing the quota available for each Member of Congress from 4,000 to 5,000 copies.

The following table shows the Farmers' Bulletins issued during the year and the total number of copies:

Farmers' Bulletins issued during the year.

Originals and reprints.	Number of bulletins.	Number of copies.
Originals	22	520,000
Reprints	154	1,917,000
Total	176	2,437,000
Total for fiscal year 1898.....	96	2,170,000

The following table gives the cost of printing the Farmers' Bulletins issued during the year. A comparison shows a very small increase in expenditure as compared with the increase in the number of bulletins issued.

Cost of printing Farmers' Bulletins.

Items.	Number of bulletins.	Cost.
Paid from Farmers' Bulletin fund.....	141	\$29,957.49
Paid from general printing fund ¹	35	6,611.59
Total	176	36,569.08
1898	96	32,756.46

¹Paid from general printing fund of the previous year, \$1,605.03.

The rapid growth in the total number of copies of Farmers' Bulletins issued since the special appropriation for the purpose in 1895, and the distribution to Members of Congress, is shown in the following:

Number of copies of Farmers' Bulletins issued (Nos. 1 to 100) and number distributed to Members of Congress.

Date.	Total number of copies issued.	Distributed to Members of Congress.
Prior to 1894.....	540,000	-----
In 1894.....	278,500	-----
In 1895.....	1,767,000	883,770
In 1896.....	1,891,000	1,316,695
In 1897.....	2,387,000	1,967,237
In 1898.....	2,170,000	1,580,065
In 1899.....	2,437,000	1,101,985
Total	11,270,500	6,851,752

The following shows the number of new Farmers' Bulletins issued each year since 1895, prior to which time, as appears above, comparatively few bulletins of this series were issued:

New Farmers' Bulletins issued from 1895 to 1899, inclusive.

Years.	Number of bulletins.
In 1895.....	11
In 1896.....	13
In 1897.....	16
In 1898.....	21
In 1899.....	22
Total.....	83

The following table shows the number and titles of new Farmers' Bulletins issued during the year and the editions of each, the total number of copies being more than half a million:

New Farmers' Bulletins issued during the year.

No. of bulletin.	Title of bulletin.	Total number of copies.
79	Experiment Station Work—VI.....	20,000
	Reprints.....	15,000
80	The Peach Twig Borer; An Important Enemy of Stone Fruits.....	10,000
	Reprint.....	10,000
81	Corn Culture in the South.....	10,000
	Reprints.....	30,000
82	The Culture of Tobacco.....	30,000
	Reprints.....	20,000
83	Tobacco Soils.....	20,000
	Reprint.....	10,000
84	Experiment Station Work—VII.....	20,000
	Reprint.....	15,000
85	Fish as Food.....	20,000
	Reprint.....	10,000
86	Thirty Poisonous Plants.....	30,000
	Reprint.....	20,000
87	Experiment Station Work—VIII.....	30,000
88	Alkali Lands.....	20,000
	Reprint.....	10,000
89	Cowpeas.....	25,000
	Reprint.....	5,000
90	The Manufacture of Sorghum Sirup.....	25,000
91	Potato Diseases and Their Treatment.....	30,000
92	Experiment Station Work—IX.....	30,000
93	Sugar as Food.....	20,000
94	The Vegetable Garden.....	30,000
95	Good Roads for Farmers.....	30,000
96	Raising Sheep for Mutton.....	30,000
97	Experiment Station Work—X.....	20,000
98	Suggestions to Southern Farmers.....	20,000
99	Three Insect Enemies of Shade Trees.....	20,000
100	Hog Raising in the South.....	30,000
	Total.....	665,000

LIST OF FARMERS' BULLETINS.

The following is a list of all the Farmers' Bulletins issued to June 30, 1899:

List of Farmers' Bulletins issued to June 30, 1899.

[Bulletins printed in *italic* type are no longer available for distribution.]

- No. 1. *The What and Why of Agricultural Experiment Stations.*
- No. 2. *The Work of the Agricultural Experiment Stations.*
- No. 3. *Culture of the Sugar Beet.*
- No. 4. *Fungous Diseases of the Grape and Their Treatment.*
- No. 5. *Treatment of Smuts of Oats and Wheat.*
- No. 6. *Tobacco: Instructions for Its Cultivation and Curing.*
- No. 7. *Spraying Fruits for Insect Pests and Fungous Diseases, with a Special Consideration of the Subject in Its Relation to the Public Health.*
- No. 8. *Results of Experiments with Inoculation for the Prevention of Hog Cholera.*
- No. 9. *Milk Fermentations and Their Relation to Dairying.*
- No. 10. *The Russian Thistle and Other Troublesome Weeds in the Wheat Region of Minnesota and North Dakota.*
- No. 11. *The Rape Plant: Its History, Culture, and Uses.*
- No. 12. *Nostrums for Increasing the Yield of Butter.*
- No. 13. *Cranberry Culture.*
- No. 14. *Fertilizers for Cotton.*
- No. 15. *Some Destructive Potato Diseases: What They Are and How to Prevent Them.*
- No. 16. *Leguminous Plants for Green Manuring and for Feeding.*
- No. 17. *Peach Yellow and Peach Rosette.*
- No. 18. *Forage Plants for the South.*

- No. 19. Important Insecticides: Directions for Their Preparation and Use.
- No. 20. Washed Soils: How to Prevent and Reclaim Them.
- No. 21. Barnyard Manure.
- No. 22. Feeding Farm Animals.
- No. 23. Foods: Nutritive Value and Cost.
- No. 24. Hog Cholera and Swine Plague.
- No. 25. Peanuts: Culture and Uses.
- No. 26. Sweet Potatoes: Culture and Uses.
- No. 27. Flax for Seed and Fiber.
- No. 28. Weeds: And How to Kill Them.
- No. 29. Souring of Milk and Other Changes in Milk Products.
- No. 30. Grape Diseases on the Pacific Coast.
- No. 31. Alfalfa, or Lucern.
- No. 32. Silos and Silage.
- No. 33. Peach Growing for Market.
- No. 34. Meats: Composition and Cooking.
- No. 35. Potato Culture.
- No. 36. Cotton Seed and Its Products.
- No. 37. Kafir Corn: Characteristics, Culture, and Uses.
- No. 38. Spraying for Fruit Diseases.
- No. 39. Onion Culture.
- No. 40. Farm Drainage.
- No. 41. Fowls: Care and Feeding.
- No. 42. Facts About Milk.
- No. 43. Sewage Disposal on the Farm.
- No. 44. Commercial Fertilizers.
- No. 45. Some Insects Injurious to Stored Grain.
- No. 46. Irrigation in Humid Climates.
- No. 47. Insects Affecting the Cotton Plant.
- No. 48. The Manuring of Cotton.
- No. 49. Sheep Feeding.
- No. 50. Sorghum as a Forage Crop.
- No. 51. Standard Varieties of Chickens.
- No. 52. The Sugar Beet.
- No. 53. How to Grow Mushrooms.
- No. 54. Some Common Birds in Their Relation to Agriculture.
- No. 55. The Dairy Herd: Its Formation and Management.
- No. 56. Experiment Station Work—I.
- No. 57. Butter Making on the Farm.
- No. 58. The Soy Bean as a Forage Crop.
- No. 59. Bee Keeping.
- No. 60. Methods of Curing Tobacco.
- No. 61. Asparagus Culture.
- No. 62. Marketing Farm Produce.
- No. 63. Care of Milk on the Farm.
- No. 64. Ducks and Geese.
- No. 65. Experiment Station Work—II.
- No. 66. Meadows and Pastures.
- No. 67. Forestry for Farmers.
- No. 68. The Black Rot of the Cabbage.
- No. 69. Experiment Station Work—III.
- No. 70. Principal Insect Enemies of the Grape.
- No. 71. Some Essentials in Beef Production.
- No. 72. Cattle Ranges of the Southwest.
- No. 73. Experiment Station Work—IV.
- No. 74. Milk as Food.
- No. 75. The Grain Smuts.
- No. 76. Tomato Growing.
- No. 77. The Liming of Soils.
- No. 78. Experiment Station Work—V.
- No. 79. Experiment Station Work—VI.
- No. 80. The Peach Twig-Borer—An Important Enemy of Stone Fruits.
- No. 81. Corn Culture in the South.
- No. 82. The Culture of Tobacco.
- No. 83. Tobacco Soils.
- No. 84. Experiment Station Work—VII.
- No. 85. Fish as Food.
- No. 86. Thirty Poisonous Plants.
- No. 87. Experiment Station Work—VIII.

- No. 88. Alkali Lands.
- No. 89. Cowpeas.
- No. 90. The Manufacture of Sorghum Sirup.
- No. 91. Potato Diseases and Their Treatment.
- No. 92. Experiment Station Work—IX.
- No. 93. Sugar as Food.
- No. 94. The Vegetable Garden.
- No. 95. Good Roads for Farmers.
- No. 96. Raising Sheep for Mutton.
- No. 97. Experiment Station Work—X.
- No. 98. Suggestions to Southern Farmers.
- No. 99. Three Insect Enemies of Shade Trees.
- No. 100. Hog Raising in the South.

SEGREGATION OF THE WEATHER BUREAU PRINTING FUND.

Under your order, addressed to the chief of the Weather Bureau, dated June 21, 1899, the editor and chief of the publications division of the Weather Bureau is authorized to draw the necessary requisitions upon the Public Printer for the printing work of the Bureau within the limit of the specific appropriation of \$10,000 for Weather Bureau printing, included in the total amount assigned from the public printing fund for the use of this Department. By this order the Weather Bureau printing is completely segregated from the printing work of the Department.

REQUISITIONS FOR PRINTING.

The total number of requisitions for printing prepared in the Division was 2,310 (aside from those which for some reason or other were subsequently canceled, and which numbered 32). Of these, 658 were drawn on the Government Printing Office and 1,652 on the branch office. For 1898 these figures were, respectively, 510 and 1,380; total, 1,890.

GOVERNMENT PRINTING OFFICE.

The requisitions on the Government Printing Office were for the several divisions of the Department as follows:

Requisitions on the Government Printing Office, by Bureaus, Divisions, Offices, etc.

Secretary's Office.....	11
Accounts and Disbursements	32
Agrostology	25
Animal Industry	65
Biological Survey	28
Botany	29
Chemistry	24
Entomology	29
Experiment Stations.....	132
Fibers.....	2
Foreign Markets	20
Forestry	28
Gardens and Grounds	2
Library	11
Pomology	5
Publications.....	19
Public Road Inquiries.....	12
Soils	19
Statistics.....	26
Vegetable Physiology and Pathology	20
Weather Bureau	96

Seed	6
Supply	1
Appointment Clerk	4
Miscellaneous	12
Total	658

THE BRANCH PRINTING OFFICE.

The branch office continues, as heretofore, to fulfill its purpose in a most efficient manner, under the direction of Mr. Frank Wallace, foreman.

The number of requisitions drawn upon the foreman of the office during the year was 1,652, or about $5\frac{1}{2}$ jobs of work daily. The requisitions were for the several Bureaus, Divisions, Offices, etc., as follows:

Requisitions on the branch printing office, by Bureaus, Divisions, Offices, etc.

Secretary's Office	5
Accounts and Disbursements	30
Agrostology	51
Animal Industry	235
Biological Survey	31
Botany	156
Chemistry	120
Entomology	59
Experiment Stations	155
Foreign Markets	25
Forestry	48
Gardens and Grounds	8
Library	23
Pomology	21
Publications	177
Public Road Inquiries	20
Soils	16
Statistics	277
Vegetable Physiology and Pathology	24
Supply	38
Chief Clerk	44
Seed	32
Appointment Clerk	48
Museum	1
Chief Engineer	3
File room	1
Telephone operator	1
Paris Exposition	1
Miscellaneous	2
Total	1,652

The character and amount of the job work done in the branch office were as follows:

Job work done in branch printing office.

Envelopes	784,460
Letter heads and note heads	748,160
Cards	361,106
Bulletins with covers	6,500
Circulars	941,560
Blanks	3,592,640
Labels and shipping tags	872,354
Franks	6,999,550
Monthly and other lists	401,722
Miscellaneous	271,559
Total	14,979,611

With its increased facilities the branch office is prepared to print many circulars and even small bulletins which formerly had to be sent to the Government Printing Office. The following table shows the number of publications printed for the various Bureaus, Divisions, and Offices in the branch office during the year:

Publications printed in branch printing office.

Bureaus, Divisions, and Offices.	Requisitions.	Number of copies printed.
Agrostology	11	57,700
Animal Industry	10	38,000
Botany	3	15,500
Chemistry	1	2,000
Entomology	13	50,500
Experiment Stations	2	5,000
Foreign Markets	2	4,000
Forestry	1	15,500
Pomology	1	2,500
Publications	15	422,000
Public Road Inquiries	9	75,000
Statistics	4	96,500
Vegetable Physiology and Pathology	2	2,000
Total	74	785,700

THE SALE OF PUBLICATIONS.

The Superintendent of Documents is charged with the sale of public documents, including all those of this Department with the exception of the card index of the Office of Experiment Stations and the publications of the Weather Bureau. By the courtesy of this officer, I am enabled to give the figures of these sales by comparison with the sale of documents from other Departments of the Government for the past year. His figures, to which I subjoin for comparison corresponding figures for 1898, are as follows:

Number of publications sold and amount received.

Department.	Publications sold.		Amount received.	
	1899.	1898.	1899.	1898.
Department of Agriculture	18,750	17,740	\$2,154.45	\$2,089.15
All other Departments	8,058	3,623	5,401.66	2,448.12
Total	26,808	21,363	7,556.11	4,537.27

It appears, therefore, that 70 per cent of the document sale and 28½ per cent of the amount received was on account of the publications of the Department of Agriculture. The Superintendent of Documents says: "While I have not kept any statistics as to the number of documents of your Department applied for that could not be supplied, I would estimate them at 20 per cent of the number sold."

This would make the total of publications of this Department applied for by persons able and willing to pay for them 22,700.

The above figures vindicate my oft-repeated contention, that there are many people able and willing to pay for such publications, and I suggest that no better way can be found to meet the requirements of the people in regard to Government publications. Every person undoubtedly has an equal right with every other person to anything we publish, and the only way to avoid unjust discrimination is to exact a small charge just sufficient to cover cost.

ILLUSTRATIONS.

The total number of illustrations reproduced for publication was 1,075, costing in all \$1,520.60, apportioned between the several divisions and charged to the several funds, as shown in the following table:

Number and cost of illustrations, by Bureaus, Divisions, and Offices.

Bureaus, Divisions, and Offices.	Number of illustrations.	Cost of illustrations.	Amount chargeable to divisional funds	Amount chargeable to illustration funds.
Soils.....	2	\$1.25	\$1.25	-----
Agrostology.....	94	176.25	176.25	-----
Animal Industry.....	45	269.18	264.73	\$4.45
Biological Survey.....	13	314.35	314.35	-----
Botany.....	69	196.28	-----	196.28
Chemistry.....	4	4.55	-----	4.55
Entomology.....	85	132.69	132.69	-----
Experiment Stations.....	13	222.69	221.25	1.44
Fiber Investigations.....	3	1.50	-----	1.50
Forestry.....	<i>a</i> 683	83.20	83.20	-----
Gardens and Grounds.....	4	4.00	-----	4.00
Irrigation Investigations.....	1	5.28	5.28	-----
Publications.....	18	27.12	-----	27.12
Public Road Inquiries.....	26	38.72	-----	38.72
Vegetable Physiology and Pathology.....	13	37.63	16.46	21.17
Weather Bureau.....	2	5.91	-----	5.91
	1,075	1,520.60	-----	305.14
Artists' supplies.....		119.66	-----	119.66
Total.....		1,640.26	1,215.46	424.80

a Photographs.

Work of the section of illustrations.

Number of drawings, retouching photographs, etc., made by the artists in the Division of Publications during fiscal year 1898-99	1,269
Number of reproductions during fiscal year 1898-99	469
Number of duplicates furnished to correspondents on 159 requests	1,261
Number of requisitions and authorizations	62
Number of illustrations printed or published during fiscal year 1898-99 (not including reprints)	1,642

PROCURING ILLUSTRATION WORK.

Owing to the limited funds at the disposal of this Division for illustrations and engravings, nearly all such work was obtained during the year through the Public Printer, the cost thereof being defrayed from the general printing fund. While the illustrations procured in this way have generally been satisfactory, it is still sometimes very desirable for the Department to furnish its own cuts or printed plates, and it is hoped that during the ensuing year more of the appropriation to this Division for illustrations may be utilized. As a matter of information, it might be stated that when illustrations are furnished by the Government Printing Office this Department has no authority to designate, though it may recommend, from whom they shall be procured. To avail itself, however, of the constant improvements in all kinds of illustrations, and with a view to considering their adaptability and general utility, it is sometimes advisable to purchase them from the engravers. Some of the divisions of the Department have special funds which may be expended in this manner. It is believed that the practice of introducing half-tone illustrations in the text should be

discouraged and their use restricted to full-page plates, in which form the results attained are far more satisfactory. Line engravings and woodcuts are particularly suitable for text figures, and in both the preparatory drawing and engraving this Division is prepared to assist.

Delay would always be avoided if this Division could begin the drawing of the illustrations to accompany a bulletin or report as soon as its publication is approved, but before the manuscript is submitted.

USE OF DEPARTMENT ILLUSTRATIONS.

During the year 159 requests were received for the use of illustrations that have appeared in various publications of the Department, the total number of cuts duplicated being 1,261, as compared with 1,188 during the preceding year. These requests come from the publishers of agricultural and other papers, who reprint portions of the Department bulletins and desire to use the illustrations in them. Under the present arrangement applicants do not receive the original cuts, but they are supplied with electrotypes of the same at the nominal cost of electrotyping, the amount being payable on receipt of the electros to the electrotypers, to whom the original cuts are sent by this office. By this plan the publishers obtain cuts as good as those in the Department bulletins at a very small cost. It is not deemed advisable to send original cuts to applicants, because the usage and injury to which they would be subjected would soon render them valueless. Moreover, it is only by keeping them in our possession that it is possible to order electros for several persons at one time, which is often very desirable. There is a gradual increase in this branch of the divisional work, which is very gratifying, since it indicates the popularity of the publications as well as bears testimony to the excellence of the illustrations.

THE YEARBOOK.

The Yearbook for 1898 was prepared upon practically the same lines as those followed with previous issues of this publication. It contained in addition to the report of the Secretary of Agriculture thirty-six articles prepared entirely by the employees of this Department with but two exceptions, and in these cases the articles were contributed by gentlemen holding special commissions as correspondents of the Department. A special effort was made to add to the value of the Appendix by giving to it something of the character of an agricultural directory. An attempt was made to secure lists as complete as possible of the principal State officials having charge of agriculture in the several States, of managers of farmers' institutes, national and State dairy officials, and of the several associations of horse, sheep, and swine breeders, with their secretaries, of State veterinarians and State forestry officers, and officers of horticultural and kindred societies. It is here respectfully submitted that in view of the importance of a complete directory of this character, to be issued yearly by the Department as a part of its Yearbook, the Secretary of Agriculture might feel disposed to call special attention to this matter in his report.

Thanks to the energetic and painstaking efforts of the force of this Division, and to the cordial and efficient cooperation of the Public Printer, the Yearbook for 1898 made its appearance May 9, 1899, the earliest issue on record by fifteen days, and affording a striking and impressive contrast to the usual practice before this Division was

organized, when the Annual Reports of this Department usually appeared anywhere from twelve to eighteen months after the close of the year whose date they bore.

Of illustrations, the Yearbook contains, in addition to the frontispiece, 41 full-page plates and 136 text figures, while the index, after the most careful pruning, fills 40 printed pages, supplying ample evidence of the variety of the contents of this publication. The selection by the Secretary of Agriculture for a frontispiece of this Yearbook of the portrait of the Hon. J. M. Rusk was generally recognized and favorably commented upon as a most graceful tribute to the memory of the first deceased Secretary of Agriculture.

While the efforts to secure for the use of this Department an increase in the number of Yearbooks assigned to it by Congress have been hitherto unavailing, it is nevertheless my duty to again call attention to the utterly inadequate supply of this book provided for the use of the Secretary. It would seem to be sufficient, in order to emphasize this fact, to state that the number of copies of the Yearbook assigned to the Department, now that the total edition consists of 500,000 copies, is no greater than it was ten years ago, when the total edition consisted of no more than 300,000 copies and the correspondents of the Department did not number 40 per cent of those at present on our list.

THE DOCUMENT SECTION.

The distribution of public documents is regulated by section 92 of the act providing for the public printing and binding, etc., approved January 12, 1895, which reads as follows:

SEC. 92. Government publications printed for or received by the Executive Departments, whether for official use or for distribution, shall be distributed by a competent person detailed to such duty in each Department by the head thereof. He shall keep an account in detail of all the publications received and distributed by him. He shall prevent duplication, and make detailed report to the head of the Department, who shall transmit the same annually to Congress.

The Department Editor, who, as stated, is also the chief of the Division of Publications, is the person charged with the supervision of the distribution under this act of all the Department publications. In this work he has the help of an assistant in charge of the document section and of an employee of the Weather Bureau, the latter having supervision of the distribution of Weather Bureau publications only.

To comply as fully as possible with the provisions of the law involves a great deal of labor, every order or application for publications being carefully recorded and filed and answered in some way, either by letter, typewritten forms and blanks, or by simple circulars. These last year amounted to—

Dictated letters	3, 141
Typewritten forms and blanks	4, 063
Total signed communications	7, 204
Blanks and circulars bearing printed signature	129, 628
Total	136, 832

making a total, with the other divisional correspondence, of over 142,000 communications addressed and mailed during the year.

Aside from the press notices prepared in this Division, the monthly list of publications and other circulars, and not including the distribution from the Weather Bureau, there were actually distributed through the document section over 4,500,000 (to be precise, 4,542,964)

separate publications, each one having to be recorded, picked out, wrapped, addressed, and mailed, while of the more important bound publications, and of all those specially limited by law to editions of 1,000 copies, card indexes are kept, so as not only to guard against but to make duplication impossible. In addition to this, every envelope receiving a Farmers' Bulletin is stamped with the number and title of the bulletin it contains—a trifling detail, perhaps, but which, when it has to be done nearly 2,500,000 times, becomes a very considerable labor. These details are presented fully here to answer the frequent inquiries directed to this office by those who do not stop to consider as to the necessity of so large a force in the document section.

In addition to all this labor, such clerical work as is involved in keeping a ledger account with every Senator, Representative, and Delegate for the Farmers' Bulletins, and a ledger account of every publication issued by the Department, with the exception of circulars, has to be provided, and this requires a class of work such as can not be supplied by ordinary laborers.

Another call for additional help arises from the fact that, under the regulation permitting the detail of laborers, when an emergency arises for temporary clerical work there are constant requests for assistance, resulting in a draft by the Chief Clerk from this force to other divisions, so that at times as many as twelve persons, and at no time less than three, have been absent in the service of some other chief. On an average, from four to six persons are so detailed at all times throughout the year, amounting to a reduction of our floating force by nearly 10 per cent, and, it should be remarked, this detail is invariably from the able-bodied and most efficient members of the force.

In the main, the force of the document section is composed of hard-working, painstaking, and deserving people, working, by comparison with others in the Government service, for low pay, and always with the apprehension engendered by an uncertainty of tenure which no amount of hard work can render secure. I mention these things in justice to a large number of faithful Government servants for whose remuneration more adequate provision should be made.

I take this opportunity to express my appreciation of the valuable services of Mr. Robert B. Handy, the assistant in charge of this section.

REVIEW OF PUBLICATION WORK.

A brief review of the work of this Division during the ten years of its existence shows an almost phenomenal growth, which, however, is not surprising in view of the fact that the work of publication necessarily reflects the work of all the other divisions, and therefore is increased in exact proportion to the growth of the Department. A table has been prepared showing the extent of the business done and the cost of doing it at two periods in the life of the Division, namely, in 1891, the first year when the Division was fairly organized, so as to afford an intelligent basis of comparison, and in 1899. This table gives the results obtained in proportion to the cost, the showing being most satisfactory. There was expended for actual printing, in 1891, 59.8 per cent of the total appropriation, and for editing, illustrating, and distributing of publications 40.2 per cent. In 1899 the cost of editing, illustrating, and distributing of documents absorbed only 27.1 per cent of the whole, 72.9 per cent being left available for actual printing. In other words, while the amount expended for actual printing in 1899 was greater by \$82,600 than in

1891, an increase of nearly 160 per cent, the cost of editing, illustrating, and distributing of publications was greater by only \$15,060, an increase of less than 45 per cent. These figures offer every assurance that the work of the Division has been conducted in the most systematic and economical manner. The best exemplification of this may perhaps be found in the fact that, had the cost of doing the work of the Division in 1899 borne the same proportion to the amount expended for the actual printing as in 1891, this cost would have exceeded \$90,000 instead of being only \$50,260, as shown in the table.

It is believed that consideration of the facts presented should surely incline Congress to allow such recommendations for increased expenditures and additional compensation to employees as you may be disposed to include in the estimates for the ensuing year.

Expenditures and amount of printing done in 1891 and in 1899.

Items.	1891.	1899.
Records and editing (statutory roll)	\$5,800	\$20,260
Document section (statutory roll)	8,400	
Materials	2,000	30,000
Illustrations and engraving (statutory roll)	17,000	
Materials	2,000	100,000
Printing appropriation	47,000	
Branch office	5,400	35,000
Farmers' Bulletins .....	.....
Total	87,600	185,260
Number of publications issued	124	603
Total number of copies printed	2,348,447	7,075,975
Appropriations for editing, illustrating, and distributing	35,200	50,260
For printing	52,400	135,000
Total	87,600	185,260
Editing, illustrating, and distributing	40.2	27.1
Printing	59.8	72.9

PLANS FOR 1899.

THE YEARBOOK.

Referring to the Yearbook for 1899, the appearance and distribution of which will occur in the last year of the present century, and work upon which has already begun, the plans designed to make it worthily mark the period of its publication can not be better set forth than by the reproduction of the letter addressed on the subject to the chiefs by the Secretary of Agriculture under date of May 8, 1899. This communication reads as follows:

Your attention is directed to the following extract from my Annual Report for 1898 in reference to the Yearbook for 1899:

" * * * for 1899 I am considering the propriety of making a special effort to prepare a publication which shall contain a résumé of the achievements in the United States in every branch of science as related to agriculture during the nineteenth century, for distribution at the Paris Exposition. At least 50,000 copies could be advantageously distributed, and I have no doubt Congress will vote an increased appropriation for such purpose."

A further consideration of the subject and consultation with several of the chiefs have determined me to carry out as thoroughly as possible the plan thus outlined. I desire that the Yearbook for 1899, the distribution of which will occur during the last year of this century, shall present to the reader a picture of the development of agriculture in the United States during the nineteenth century and of its condition at the present time, and show in a special manner the effect

upon the agricultural industry of the application of science in its several branches to the service of agriculture. Every Bureau and Division in the Department charged with scientific work should, therefore, contribute one or two articles reviewing the progress made in the application to agriculture of the particular science with which it is concerned.

With a full appreciation of the object to be attained, and with the experience and ability of our scientific workers, there is no doubt that a Yearbook, conceived on this plan, and efficiently executed, will present a most useful and interesting picture, adequately illustrating the present conditions of the agricultural industry in the United States, and faithfully portraying the progress made in the practical services rendered by science to agriculture during the century.

Realizing the interest which would be taken abroad in such a work, and the importance of its wide diffusion in foreign countries, I propose to invite Congress to provide for a special distribution of this work at the Paris Exposition, so as to reach scientific societies, institutions of learning, government and municipal libraries, chambers of commerce, and the leading publicists and scientists throughout Europe.

I need hardly say more than this to impress upon you the importance of the work which the carrying out of this plan entails upon you and your principal assistants, and to explain the calling upon you so much earlier in the year than usual to consider your contributions to the next Yearbook. You will, therefore, confer with me and the Editor of the Yearbook at an early day in regard to the articles which you propose to contribute in carrying out this project. I will add that for the purpose designed it will be necessary that the matter should be provided much earlier than usual, and the subject should, therefore, be taken up at once. Both text and illustrations should be in the hands of the Editor not later than October 31, 1899.

CARD INDEX OF DEPARTMENT PUBLICATIONS.

In the last two reports of this Division reference was made to the desirability and necessity of still further continuing the work of indexing the publications of the Department. The completion of an index to the Annual Reports of the Department from 1837 to 1893, to the Reports of the Statistician, 1863 to 1894, and to the authors of articles in the Department publications indicate what has been accomplished along this line. An index to the literature relating to animal industry appearing in the Department publications is now in preparation, and, though largely prepared in the Bureau of Animal Industry, will probably be issued as a publication of this Division during the present year. There yet remain many publications the contents of which would be rendered more available and consequently more valuable if they were properly indexed. It is believed that every bulletin should be provided with an index, and this office would gladly have undertaken such work if the funds would have allowed the employment of the necessary assistance. It is true that the haste with which many reports are necessarily printed offers an obstacle to making an index to them. The information which they contain would not, however, be lost if a card index were made and rendered accessible for reference. The enormous correspondence of the Department requesting information on every subject relating to agriculture and kindred topics necessitates constant reference to the publications of the Bureaus, Divisions, and Offices, which would be greatly facilitated if access were possible to a subject index of the bulletins, reports, etc. The Department ought to have a card index of every publication heretofore printed and to be hereafter issued. Every subject and every author should be indexed, and while such an undertaking would be a work of considerable magnitude, this Division hopes in the near future to be able to assign at least one person to the task, believing that it is imperatively needed, and that its preparation properly comes within the

province of the Division of Publications. The familiarity of this office with the publications is now almost the only source of information in regard to the subjects treated, but the bulletins and reports have become so numerous that some permanent and tangible record of published information is demanded, which can be most satisfactorily furnished by the card-index system, even though the index be never printed.

NEED OF ADDITIONAL ROOM.

Attention is again invited to the necessity for additional room for the accommodation of the employees in the document section, particularly for that portion of the force engaged in clerical work. The present quarters were provided when the number of persons in the section was not half as large as now; to comfortably and advantageously arrange them another room is urgently needed. This might easily and with slight expense be taken from the Museum, and it is hoped the addition may be made at an early day.

SUGGESTIONS AS TO COPY AND PROOFS.

EDITING MATTER IN PROOFS.

The practice of submitting imperfect copy and of deferring editorial revision until the matter is in proof became so common that the Secretary deemed it necessary to issue the following order:

[General Order No. 3—Supplementary.]

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., May 27, 1899.

To Chiefs of Bureaus, Offices, and Divisions :

My attention having been called to the increasing number of alterations made in the proof of matter ordered to be printed by the various offices of this Department, I desire again to remind chiefs of Bureaus, Divisions, and Offices that no matter of any description should be submitted for publication until the same has been carefully examined and revised, and is in the precise words in which it should be printed. Editing in the proof presupposes neglect in the preparation of the original copy and can not be allowed. This order applies also to work done in the branch printing office in this Department, where the late vexatious and unnecessary alterations in blanks, forms, etc., have greatly delayed the operations of the office.

I have instructed the chief of the Division of Publications, who is charged with the supervision of all the printing of the Department, to see that this order is rigidly observed.

JAMES WILSON,
Secretary.

Attest:

ANDREW GEDDES, *Chief Clerk.*

It ought to need no argument that copy for publication should be carefully revised and edited before it is submitted. Changes in the proof are troublesome and expensive, and should never be made unless absolutely necessary—as, for instance, in the correction of a misstatement or matter of fact. Alterations merely for the sake of improving the language should not be permitted. Some time ago the Public Printer estimated that the expense of making changes indicated in the proof returned to him by this Department amounted to nearly one-third of the total amount spent for printing. It will be seen,

therefore, that the evil complained of is of prodigious proportions, and that the order of the Secretary relating thereto was extremely timely and necessary. There is never anything to be gained by submitting copy before it is ready, no matter how great the haste for its publication. Proof of bulletins and reports is submitted simply for comparison with the copy; if Bureaus, Divisions, and Offices would bear this in mind, the publication work of the Department would be greatly expedited and its fund for printing conserved rather than consumed, as heretofore, by vexatious and unnecessary alterations. The introduction of the typewriter has made it easy for the author and editor to revise copy intended for publication, and there no longer exists any justification for editing in the proof because of the trouble of revising matter in the manuscript form. What has been said herein in regard to bulletins and reports applies also to blanks, blank books, etc., whether done at the Government Printing Office or in the branch office in this Department. Whatever is to be printed should be carefully prepared. It is feared that chiefs of divisions frequently approve of the publication of matter prepared by their subordinates, reserving their critical examination of details until proof is submitted—a practice that under the Secretary's order is forbidden.

UNIFORMITY IN STYLE AND SPELLING.

Uniformity in style and in spelling should be preserved in publications of the Department. This is a subject to which attention has been called in previous reports of this Division, and for the consideration of which the creation of a board has been recommended. It is admitted that each division should be considered the authority for the spelling of names and terms in the particular science with which it is concerned, and such authority should be recognized as the standard for the Department. In the absence of such an understanding no instructions can be given to the printer, who, however, as a business precaution, has adopted a style of his own, and numerous alterations too frequently are required. If the Secretary would call together representatives from the different Bureaus, Divisions, and Offices and instruct them to adopt a uniform method for the spelling of scientific and other terms used in the Department bulletins and reports, the publication work would be greatly expedited and delays and expense would be avoided.

This office is prepared to read all proof with special reference to securing typographical perfection, and if the various divisions would concern themselves only with the accuracy of the subject-matter in the proof submitted to them they would avoid the consideration of details in printing which come within the special province of this Division.

DELAY IN READING PROOF.

It is earnestly submitted that the reading of proof is as important as any work devolving upon any office in the Department, and yet it is a fact that this work in many instances is the last to receive attention. Proof of bulletins made special because of the alleged urgent need for their publication is sometimes held for weeks, and yet this office is expected to have completed copies of the bulletin in an unreasonably short time after the return of the final proof. It is unjust to expect the printer to make haste when he does not receive

the cooperation of the Department. It is due to the Public Printer to say that all work ordered from the Government Printing Office during the last year, notwithstanding the large amount and various kinds, was delivered with unusual promptness, and was, as a rule, very satisfactory.

APPENDIX A.

PUBLICATIONS ISSUED DURING THE YEAR ENDED JUNE 30, 1899.

[The following publications were issued during the year ended June 30, 1899. Those to which a price is attached, with the exception of publications of the Weather Bureau, must be obtained of the Superintendent of Documents, Union Building, Washington, D. C., to whom are turned over all copies not needed for official use, in compliance with section 67 of the act providing for the public printing and binding and the distribution of public documents. Remittances should be made to him by postal money order. Weather Bureau publications to which a price is attached must be obtained from the chief of that Bureau. Applications for those that are for free distribution should be made to the Secretary of Agriculture, Washington, D. C.]

OFFICE OF THE SECRETARY.

	Copies.
Farm Drainage. By C. G. Elliott, C. E., member of the American Society of Civil Engineers, Peoria, Ill. Pp. 24, figs. 6. Farmers' Bulletin No. 40. (Reprint.) August, 1898	10,000
Reprint, February, 1899	10,000
Reprint, June, 1899	5,000
Cultivation of Tobacco in Sumatra. By Emile Mulder. Pp. 39, figs. 3, map. September, 1898. Price 5 cents	4,000
Marketing Farm Produce. By George G. Hill, formerly manager and editor of the American Farmer, Illinois. Pp. 28, figs. 7. Farmers' Bulletin No. 62. (Reprint.) September, 1898	20,000
Reprint, June, 1899	5,000
Report of the Secretary of Agriculture, 1898. (Preliminary.) Pp. 60. December, 1898	30,000
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Aneroid Barometers. Pp. 6. January, 1899	250
Meteorological Chart of the Great Lakes. Published by authority of the Secretary of Agriculture. Willis L. Moore, Chief of Weather Bureau. January, 1899	2,100
Frost: When to Expect it and How to Lessen the Injury Therefrom. Prepared under the direction of Willis L. Moore, Chief of Weather Bureau, by W. H. Hammon, Professor of Meteorology. Pp. 37. Weather Bureau Bulletin No. 13. February, 1899	5,000
Report of the Chief of Weather Bureau, 1897-98:	
Part II. Climatology. Hourly Averages of Atmospheric Pressure, Temperature, and Wind from the Records of Automatic Instruments at Twenty-eight Stations. Pp. 87. April, 1899	250
Part III. Climatology. Monthly and Annual Meteorological Summaries. Pp. 89-165. April, 1899	500
Part IV. Climatology. Monthly and Annual Mean Temperature and Annual Extremes, Together with the Dates of First and Last Killing Frost, 1897. Pp. 167-202. April, 1899	250
Part V. Climatology. Monthly and Annual Precipitation, 1897. All Stations. Pp. 203-257. April, 1899	250
Part VI. Climatology. Miscellaneous Meteorological Tables, Charts, and Reports, Illustrating the Weather of 1897. Pp. 259-304. Charts 21. April, 1899	500
Part VII. Climatology. Climate of Cuba. By W. F. R. Phillips. Meteorological Waves, and the Distribution of Moisture in the United States. By H. A. Hazen, Professor Weather Bureau. Pp. 305-338, pls. 7, diags. 9. April, 1899	250
Proceedings of the Convention of Weather Bureau Officials held at Omaha, Nebr., October 13-14, 1898. Prepared under direction of Willis L. Moore, Chief of Weather Bureau. Edited by James Berry, Chief of Climate and Crop Division. Secretary of the Convention. Pp. 184, pl. 1. Bulletin No. 24. April, 1899	5,000
Climate and Crop Report of 1898, Alaska Section. Prepared under direction of Willis L. Moore, Chief of Weather Bureau, by H. L. Ball, Section Director, Sitka, Alaska. Pp. 7. April, 1899	300
Measurement by Precipitation. Prepared under direction of Willis L. Moore, Chief of Weather Bureau, by C. F. Marvin, Professor of Meteorology. Pp. 28, figs. 10. Circular E, Instrument Division. April, 1899	750

Copies.

Hydrology of the Lake Minnetonka Watershed. By George W. Cooley, C. E., Minneapolis, Minn. Published by direction of Willis L. Moore, Chief of Weather Bureau. Pp. 10, figs. 4. April, 1899.	750
The Use of Kites in the Exploration of the Upper Air. By C. F. Marvin, Professor of Meteorology, Weather Bureau. Pp. i-ii, 201-212, pl. 1, figs. 9, from Yearbook for 1898. May, 1899.	1,000
Cyclones, Hurricanes, and Tornadoes. By F. H. Bigelow, Professor of Meteorology, Weather Bureau. Pp. i-ii, 525-534, from Yearbook for 1898. May, 1899.	1,000
Meteorological Chart of the Great Lakes. Published by authority of the Secretary of Agriculture. Willis L. Moore, Chief of Weather Bureau. May, 1899.	2,500
Weather Forecasting: Some Facts Historical, Practical, and Theoretical. By Willis L. Moore, Chief of Weather Bureau. Pp. 16. Bulletin No. 25. June, 1899.	5,000
Lightning and Electricity of the Air. In Two Parts. Prepared under direction of Willis L. Moore, Chief of Weather Bureau, by Alexander G. MacAdie and Alfred J. Henry. Pp. 74, figs. 19, pls. 4. Bulletin No. 26. June, 1899.	5,000
Meteorological Chart of the Great Lakes. Published by authority of the Secretary of Agriculture. Willis L. Moore, Chief of Weather Bureau. June, 1899.	3,000
Meteorological Chart of the Great Lakes. Published by authority of the Secretary of Agriculture. Willis L. Moore, Chief of Weather Bureau. June, 1899.	2,700
Climate and Crop Bulletin No. 16. July 4, 1898.	4,400
Climate and Crop Bulletin No. 17. July 11, 1898.	4,400
Climate and Crop Bulletin No. 18. July 18, 1898.	4,400
Climate and Crop Bulletin No. 19. July 25, 1898.	4,000
Climate and Crop Bulletin No. 20. August 1, 1898.	4,400
Climate and Crop Bulletin No. 21. August 8, 1898.	3,900
Climate and Crop Bulletin No. 22. August 15, 1898.	4,000
Climate and Crop Bulletin No. 23. August 22, 1898.	3,912
Climate and Crop Bulletin No. 24. August 29, 1898.	3,900
Climate and Crop Bulletin No. 25. September 5, 1898.	4,000
Climate and Crop Bulletin No. 26. September 12, 1898.	4,000
Climate and Crop Bulletin No. 27. September 19, 1898.	4,000
Climate and Crop Bulletin No. 28. September 26, 1898.	4,000
Climate and Crop Bulletin No. 29. October, 1898.	4,000
Climate and Crop Bulletin No. 30. November, 1898.	4,000
Climate and Crop Bulletin No. 31. December, 1898.	4,000
Climate and Crop Bulletin No. 1. January, 1899.	4,000
Climate and Crop Bulletin No. 2. February, 1899.	4,000
Climate and Crop Bulletin No. 3. March, 1899.	4,000
Climate and Crop Bulletin No. 4. April 10, 1899.	4,000
Climate and Crop Bulletin No. 5. April 17, 1899.	4,000
Climate and Crop Bulletin No. 6. April 24, 1899.	4,100
Climate and Crop Bulletin No. 7. May 1, 1899.	4,100
Climate and Crop Bulletin No. 8. May 8, 1899.	4,000
Climate and Crop Bulletin No. 9. May 15, 1899.	4,000
Climate and Crop Bulletin No. 10. May 22, 1899.	4,000
Climate and Crop Bulletin No. 11. May 29, 1899.	4,000
Climate and Crop Bulletin No. 12. June 5, 1899.	4,000
Climate and Crop Bulletin No. 13. June 12, 1899.	4,000
Climate and Crop Bulletin No. 14. June 19, 1899.	4,000
Climate and Crop Bulletin No. 15. June 26, 1899.	4,000
Snow and Ice Chart. December 5, 1898.	1,680
Snow and Ice Chart. December 12, 1898.	1,780
Snow and Ice Chart. December 19, 1898.	1,800
Snow and Ice Chart. December 26, 1898.	1,800
Snow and Ice Chart. January 2, 1899.	1,800
Snow and Ice Chart. January 9, 1899.	1,800
Snow and Ice Chart. January 16, 1899.	1,750
Snow and Ice Chart. January 23, 1899.	1,700
Snow and Ice Chart. January 30, 1899.	1,700
Snow and Ice Chart. February 6, 1899.	1,700
Snow and Ice Chart. February 13, 1899.	1,700
Snow and Ice Chart. February 20, 1899.	1,800

	Copies.
Snow and Ice Chart. February 27, 1899.....	1,800
Snow and Ice Chart. March 6, 1899.....	1,800
Snow and Ice Chart. March 13, 1899.....	1,800
Snow and Ice Chart. March 20, 1899.....	1,800
Snow and Ice Chart. March 27, 1899.....	1,800
Daily weather map (showing weather conditions throughout the United States and giving forecasts of probable changes):	
July, 1898.....	26,250
August, 1898.....	26,580
September, 1898.....	25,640
October, 1898.....	25,940
November, 1898.....	30,980
December, 1898.....	39,800
January, 1899.....	39,900
February, 1899.....	37,100
March, 1899.....	42,100
April, 1899.....	45,000
May, 1899.....	40,750
June, 1899.....	40,400

APPENDIX B.

REPORT IN DETAIL OF PUBLICATIONS OF THE U. S. DEPARTMENT OF AGRICULTURE RECEIVED AND DISTRIBUTED DURING FISCAL YEAR ENDED JUNE 30, 1899.

[NOTE.—The publications of the Weather Bureau are not distributed from the Division of Publications, but by an official in that Bureau specially charged with such work and directed by the order of the Secretary of Agriculture, dated March 29, 1897, to report to the chief of this Division. A list of Weather Bureau publications is given in separate tables.]

Publications received and distributed from July 1, 1898, to June 30, 1899.

Publication.	Received.	Distributed.
DIVISION OF AGROSTOLOGY.		
Bulletin No. 7 (revised).....	1,000	922
Bulletin No. 11.....	1,500	1,303
Bulletin No. 12.....	5,020	1,990
Bulletin No. 13.....	3,000	922
Bulletin No. 14.....	8,000	7,853
Bulletin No. 15.....	5,070	2,452
Bulletin No. 16.....	6,000	3,560
Bulletin No. 17.....	1,000	202
Bulletin No. 18.....	1,500	1,269
Bulletin No. 19.....	1,500	200
Circular No. 4 (reprint).....	5,000	675
Circular No. 7.....	5,000	4,582
Circular No. 8.....	8,000	6,164
Circular No. 9.....	1,200	982
Circular No. 10.....	1,000	885
Circular No. 11.....	10,000	7,527
Circular No. 12.....	10,000	7,398
Circular No. 13.....	10,000	7,216
Circular No. 14.....	10,000	1,500
Report for 1898.....	500	209
BUREAU OF ANIMAL INDUSTRY.		
Bulletin No. 21.....	10,000	8,087
Bulletin No. 22.....	1,500	1,294
Bulletin No. 23.....	5,000	5,000
National and State Dairy Laws.....	3,074	1,718
Circular No. 1.....	2,500	856
Circular No. 23.....	15,000	3,673
Circular No. 24.....	9,000	8,619
Circular No. 25.....	3,500	670
Circular No. 26.....	4,000	4,000
Report for 1898.....	9,300	4,243
Fourth Annual Report.....	9,000	4,187

Publications received and distributed from July 1, 1898, to June 30, 1899—Cont'd.

Publication.	Received.	Distrib- uted.
BIOLOGICAL SURVEY.		
Bulletin No. 9.....	4,100	3,636
Bulletin No. 10.....	5,000	4,882
Bulletin No. 11.....	5,000	4,842
North American Fauna No. 10 (reprint).....	1,000	-----
North American Fauna No. 12 (reprint).....	1,000	-----
North American Fauna No. 13 (reprint).....	1,080	1,080
North American Fauna No. 14.....	3,000	2,629
Reptiles of the Tres Marias and Isabel Islands.....	100	100
Notes on the Crustacea of the Tres Marias Islands.....	100	100
Plants of the Tres Marias Islands.....	100	100
Report for 1898.....	500	379
DIVISION OF BOTANY.		
Bulletin No. 17 (reprint).....	500	187
Bulletin No. 18 (reprint).....	500	239
Bulletin No. 20.....	10,000	5,979
Bulletin No. 21.....	2,050	1,600
Circular No. 4 (reprint).....	540	539
Circular No. 13 (reprint).....	2,000	70
Circular No. 16.....	5,000	912
Circular No. 17.....	8,500	4,554
Seed and Plant Inventory No. 1.....	5,000	3,435
Seed and Plant Inventory No. 3.....	500	458
Seed and Plant Inventory No. 4.....	500	222
Report for 1898.....	500	209
Contributions from U. S. Herbarium, vol. 3.....	500	50
DIVISION OF CHEMISTRY.		
Bulletin No. 13, part 9.....	1,000	1,000
Bulletin No. 46 (revised).....	1,500	1,443
Bulletin No. 50.....	5,000	4,534
Bulletin No. 51 (reprint).....	1,040	421
Bulletin No. 52 (revised).....	2,000	1,550
Bulletin No. 53.....	5,100	903
Bulletin No. 54.....	2,025	1,938
Bulletin No. 55.....	6,150	3,743
Bulletin No. 56.....	1,000	891
Circular No. 5.....	2,000	1,029
Report for 1898.....	500	221
Special Report on Beet Sugar Industry in the United States, 1897.....	19,535	11,720
Special Report on Beet Sugar Industry in the United States, 1898.....	20,040	6,076
Food Adulteration (reprint) from Bulletin No. 51.....	1,000	342
DIVISION OF ENTOMOLOGY.		
Bulletin No. 4 (revised, reprint).....	1,000	-----
Bulletin No. 14.....	5,008	2,496
Bulletin No. 15.....	5,050	3,599
Bulletin No. 16.....	5,034	3,588
Bulletin No. 17.....	2,530	1,846
Bulletin No. 18.....	5,000	2,536
Bulletin No. 19.....	3,000	2,495
A Destructive Borer Enemy of Birch Trees.....	700	408
San Jose Scale on Dried Fruits.....	500	106
A New Coccid on Birch.....	500	107
Circular No. 32.....	5,000	1,882
Circular No. 33.....	3,000	1,374
Circular No. 34.....	5,000	1,968
Circular No. 35.....	5,000	3,144
Circular No. 36.....	3,000	2,891
Circular No. 37.....	5,000	1,459
Circular No. 38.....	3,000	1,374
Circular No. 39.....	5,000	1,347
Report for 1898.....	500	218
OFFICE OF EXPERIMENT STATIONS.		
Bulletin No. 11 (reprint).....	1,000	-----
Bulletin No. 21 (reprint).....	500	243
Bulletin No. 28 (revised).....	5,000	-----
Bulletin No. 43 (reprint).....	3,000	546
Bulletin No. 45 (revised).....	1,000	875
Bulletin No. 53 (reprint).....	500	-----
Bulletin No. 54.....	3,550	3,373
Bulletin No. 55.....	3,540	2,663
Bulletin No. 56.....	4,000	3,441
Bulletin No. 57.....	3,000	2,174
Bulletin No. 58.....	11,000	7,888
Bulletin No. 59.....	3,500	2,600

Publications received and distributed from July 1, 1898, to June 30, 1899—Cont'd.

Publication.	Received.	Distrib- uted.
OFFICE OF EXPERIMENT STATIONS—Continued.		
Bulletin No. 60	4,000	1,882
Bulletin No. 61	2,000	1,973
Bulletin No. 62	2,500	2,149
Bulletin No. 64	3,000	1,885
Bulletin No. 65	1,000	1,000
Bulletin No. 66	2,000	1,404
Experiment Station Record, Vol. IX, No. 12	4,500	4,500
Experiment Station Record, Vol. X, No. 1	4,520	4,296
Experiment Station Record, Vol. X, No. 2	4,505	4,260
Experiment Station Record, Vol. X, No. 3	4,500	4,032
Experiment Station Record, Vol. X, No. 4	4,500	4,305
Experiment Station Record, Vol. X, No. 5	4,500	4,340
Experiment Station Record, Vol. X, No. 6	4,500	4,085
Experiment Station Record, Vol. X, No. 7	4,500	4,278
Experiment Station Record, Vol. X, No. 8	4,500	4,257
Experiment Station Record, Vol. X, No. 9	4,500	4,104
Experiment Station Record, Vol. X, No. 10	4,500	4,500
Experiment Station Record, Vol. X, No. 11	4,500	451
Circular No. 38	3,137	2,235
Circular No. 39	3,000	2,585
Circular No. 40	2,000	1,700
Report for 1898	2,600	2,600
Scandinavian Seed Control Station	200	76
Physical and Meteorological Researches	250	103
Investigations on the Metabolism of Milch Cows	200	200
DIVISION OF FORESTRY.		
Bulletin No. 13 (reprint)	1,000	328
Bulletin No. 17	5,000	1,879
Bulletin No. 18	5,000	3,278
Bulletin No. 19	4,215	2,253
Bulletin No. 20	4,000	2,078
Bulletin No. 21	8,155	1,768
Circular No. 18	1,000	437
Circular No. 19	11,500	9,801
Circular No. 21	15,000	11,766
Report for 1898	500	360
OFFICE OF FIBER INVESTIGATIONS.		
Report No. 9 (reprint)	1,000	621
Report No. 10 (and reprint)	5,005	4,023
Report No. 11	4,150	1,691
SECTION OF FOREIGN MARKETS.		
Bulletin No. 7 (revised)	4,000	3,443
Bulletin No. 8 (revised)	4,000	3,441
Bulletin No. 10 (reprint)	2,000	1,987
Bulletin No. 12 (reprint)	3,089	1,995
Bulletin No. 13 (reprint)	15,105	9,791
Bulletin No. 14 (reprint)	15,160	14,180
Bulletin No. 15	16,450	2,415
Report for 1898	4,000	3,795
Circular No. 15 (reprint)	2,000	174
Circular No. 17 (reprint)	2,000	348
Circular No. 18 (revised)	5,100	400
Circular No. 21	37,900	37,895
LIBRARY.		
Bulletin No. 23	1,050	1,011
Bulletin No. 24	1,040	1,037
Bulletin No. 25	1,000	999
Bulletin No. 26	1,000	1,000
Bulletin No. 27	1,200	391
DIVISION OF POMOLOGY.		
Bulletin No. 7 (reprint)	10,000	9,053
Circular No. 3 (reprint)	2,500	1,111
Nut Culture in the United States (reprint)	1,015	300
Report for 1898	300	300
DIVISION OF PUBLICATIONS.		
Bulletin No. 1 (reprint)	500	721
Bulletin No. 3 (revised)	3,000	851
Bulletin No. 4	1,040	851
Report for 1898	1,500	1,116
List of Free Bulletins and Circulars, No. 247	5,000	4,847
Publications for Sale by Superintendent of Documents, No. 179	30,000	4,912

Publications received and distributed from July 1, 1898, to June 30, 1899—Cont'd.

Publication.	Received.	Distrib- uted.
OFFICE OF PUBLIC ROAD INQUIRIES.		
Bulletin No. 5 (reprint)	1,000	294
Bulletin No. 19 (reprint)	1,000	250
Circular No. 14 (reprint)	10,350	1,267
Circular No. 15 (reprint)	10,000	1,083
Circular No. 18 (reprint)	10,000	269
Circular No. 23 (reprint)	10,000	1,675
Circular No. 24 (reprint)	10,000	624
Circular No. 26 (reprint)	10,000	1,279
Circular No. 29 (reprint)	14,000	819
Circular No. 31	7,850	7,804
Circular No. 32	10,000	8,471
Circular No. 33	10,000	9,421
Report for 1898	500	243
DIVISION OF STATISTICS.		
Miscellaneous Bulletin No. 13 (reprint)	1,200	391
Miscellaneous Bulletin No. 15	22,645	16,560
Miscellaneous Bulletin No. 16	27,000	25,607
Circular No. 9	20,000	22,062
Report for 1898	500	259
Crop Circular for July, 1898	196,000	180,914
Crop Circular for August, 1898	198,000	193,197
Crop Circular for September, 1898	200,000	132,413
Crop Circular for October, 1898	152,400	115,993
Crop Circular for November, 1898	145,000	116,171
Crop Circular for May, 1899	193,000	188,782
Crop Circular for June, 1899	194,400	187,246
Report No. 156	80,000	71,571
The Crop Reporter for May, 1899	32,000	32,000
The Crop Reporter for June, 1899	32,000	32,000
DIVISION OF SOILS.		
Bulletin No. 4 (reprint)	500	346
Bulletin No. 5 (reprint)	300	181
Bulletin No. 14	5,000	3,399
Bulletin No. 15 (reprint)	2,575	607
Report for 1898	300	208
DIVISION OF VEGETABLE PHYSIOLOGY AND PATHOLOGY.		
Bulletin No. 11 (reprint)	200	49
Circular No. 16	2,000	1,644
Circular No. 17	3,000	2,926
Report for 1898	300	209
MISCELLANEOUS.		
Report No. 59	3,500	2,742
Report No. 60	5,000	2,076
Cultivation of Tobacco in Sumatra	4,000	3,635
Market for American Horses in Foreign Countries	20,200	7,489
Senate Document No. 124	3,000	1,313
Report of the Chief of the Division of Accounts and Disbursements for 1898	250	205
Water as a Factor in the Growth of Plants	500	22
Mineral Phosphates as Fertilizers	200	59
Grasses as Sand and Soil Binders	500	286
Best Roads for Farms and Farming Districts	1,000	416
State Highways in Massachusetts	1,000	504
Improvement of Public Roads in North Carolina	1,000	383
The Meadow Lark and Baltimore Oriole	1,500	3
Small-Fruit Culture for Market	5,000	907
The Pineapple Industry in the United States	2,000	402
The Blue Jay and Its Food	1,500	9
The Superior Value of Large, Heavy Seed	500	265
Potash and Its Functions in Agriculture	500	498
Division of Agrostology	2,000	86
Lawns and Lawn Making	5,000	740
Utilization of By-Products of the Dairy	6,000	4,975
Additional Notes on Seed Testing	300	275
Every Farm an Experiment Station	500	260
Agricultural Production and Prices	1,000	199
Sand-Binding Grasses	1,000	625
Millet	3,000	1,420
Forage Plants for Cultivation on Alkali Soils	1,000	369
Cattle Dipping	5,000	285
The Preparation and Use of Tuberculin	5,000	322
The Danger of Introducing Noxious Animals and Birds	3,000	1,532
Birds as Weed Destroyers	3,000	1,759
Weeds in Cities and Towns	2,000	246

Publications received and distributed from July 1, 1898, to June 30, 1899—Cont'd.

Publication.	Received.	Distrib- uted.
MISCELLANEOUS—continued.		
Can Perfumery Farming Succeed in the United States?.....	2,500	547
Grass Seed and Its Impurities.....	2,500	129
Utilization of Residues from Beet Sugar.....	1,000	258
The Principal Insects Affecting Tobacco Plants.....	500	459
Insects Injurious to Beans and Peas.....	2,500	397
Some Types of American Agricultural Colleges.....	500	127
Some Results of Dietary Studies in the United States.....	2,500	2,109
Agricultural Experiments in Alaska.....	200	167
Notes on Some Forest Problems.....	8,100	302
Work of the Division of Forestry for the Farmer.....	8,100	295
Pruning of Trees and Other Plants.....	1,000	692
Utilizing Surplus Fruits.....	1,000	583
The Present Condition of Grape Culture in California.....	500	429
Notes on Some English Farms and Farmers.....	200	75
Steel-Track Wagon Roads.....	3,000	414
Construction of Good Country Roads.....	3,000	468
Agriculture in Puerto Rico.....	2,000	358
The Movement and Retention of Water in Soils.....	300	291
The Soluble Mineral Matter of Soils.....	300	292
Public Domain in the United States.....	10,000	459
Keeping Goats for Profit.....	10,000	1,782
Agricultural Statistics.....	25,000	1,705
Pollination of Pomaceous Fruits.....	1,000	374
Work in Vegetable Physiology and Pathology.....	200	200
Improvement of Plants by Selection.....	2,000	372
The Use of Kites in the Exploration of the Upper Air.....	1,000	1,000
Cyclones, Hurricanes, and Tornadoes.....	1,000	689
The Hawaiian Islands.....	2,000	226
A Directory for Farmers.....	2,000	438
Report of the Secretary for 1898.....	30,600	9,720
Annual Reports Department of Agriculture for 1898.....	3,000	2,690
Yearbook of the Department, 1898. (Cloth).....	29,600	19,625
Yearbook of the Department, 1898. (Extra bound).....	400	25
Total of new.....	2,550,292	1,879,592
Publications printed prior to July 1, 1898, on hand.....	930,825	183,997
Total.....	3,481,117	2,063,589
By balance on hand.....		1,417,528
Total.....	3,481,117	3,481,117

Farmers' Bulletins printed, and Congressional and miscellaneous distribution, for the fiscal year 1898-99.

No. of bulletin.	Title of bulletin.	Total number received.	Distrib- uted to Congress- men.	Miscella- neous dis- tribution.
6	Tobacco: Instructions for its Cultivation and Curing.....		771	202
11	The Rape Plant.....		102	147
14	Fertilizers for Cotton.....		2	356
15	Some Destructive Potato Diseases: What They Are and How to Prevent Them.....		19,988	6,195
16	Leguminous Plants for Green Manuring and Feeding.....	20,800	6,277	7,689
17	Peach Yellows and Peach Rosette.....		258	1,045
18	Forage Plants for the South.....	500	4,896	2,013
19	Important Insecticides: Directions for Their Prepa- ration and Use.....	35,000	13,167	9,144
20	Washed Soils.....	15,200	29	1,119
21	Barnyard Manure.....	45,910	11,160	8,153
22	Feeding Farm Animals.....	76,755	35,768	10,921
23	Foods: Nutritive Value and Cost.....	40,870	12,272	13,935
24	Hog Cholera and Swine Plague.....	82,050	44,327	26,047
25	Peanuts: Culture and Uses.....	20,110	5,350	4,620
26	Sweet Potatoes: Culture and Uses.....	30,265	12,462	6,599
27	Flax for Seed and Fiber.....	10,200	3,326	2,067
28	Weeds, and How to Kill Them.....	30,150	14,145	9,167
29	Souring of Milk and Other Changes in Milk Products.....	30,200	12,256	5,552
30	Grape Diseases on the Pacific Coast.....		3,386	2,024
31	Alfalfa, or Lucern.....	20,200	12,135	5,789
32	Silos and Silage.....	26,385	7,906	5,238
33	Peach Growing for Market.....	20,400	13,559	6,422
34	Meats: Composition and Cooking.....	40,750	11,770	10,427
35	Potato Culture.....	66,085	28,288	11,238

Farmers' Bulletins printed, and Congressional and miscellaneous distribution, for the fiscal year 1898-99—Continued.

No. of bulletin.	Title of bulletin.	Total number received.	Distributed to Congressmen.	Miscellaneous distribution.
36	Cotton Seed and Its Products.....	10,560	7,356	2,739
37	Kafr Corn: Characteristics, Culture, and Uses.....	30,935	7,897	4,174
38	Spraying for Fruit Diseases.....	21,700	18,397	8,756
39	Onion Culture.....	27,300	12,430	8,400
40	Farm Drainage.....	27,300	11,805	6,285
41	Fowls: Care and Feeding.....	75,230	44,359	15,367
42	Facts about Milk.....	20,400	14,313	8,655
43	Sewage Disposal on the Farm.....	10,500	5,802	3,814
44	Commercial Fertilizers.....	25,320	14,712	6,089
45	Some Insects Injurious to Stored Grain.....	15,000	8,767	3,696
46	Irrigation in Humid Climates.....	10,000	2,797	2,609
47	Insects Affecting the Cotton Plant.....	20,030	10,309	1,728
48	The Manuring of Cotton.....	20,100	10,592	1,933
49	Sheep Feeding.....	25,300	19,227	6,257
50	Sorghum as a Forage Crop.....	20,330	12,445	4,288
51	Standard Varieties of Chickens.....	70,090	55,134	13,797
52	The Sugar Beet.....	47,845	35,475	9,858
53	How to Grow Mushrooms.....	10,075	6,038	6,206
54	Some Common Birds in their Relation to Agriculture.....	40,440	21,014	11,085
55	The Dairy Herd: Its Formation and Management.....	40,175	21,944	13,940
56	Experiment Station Work—I.....	25,110	9,771	7,915
57	Butter Making on the Farm.....	61,300	27,398	9,911
58	The Soy Bean as a Forage Crop.....	10,150	6,188	3,993
59	Bee Keeping.....	40,300	22,031	12,566
60	Methods of Curing Tobacco.....	35,350	13,784	5,186
61	Asparagus Culture.....	20,270	7,887	6,537
62	Marketing Farm Produce.....	25,400	18,680	5,352
63	Care of Milk on the Farm.....	45,300	24,926	15,767
64	Ducks and Geese.....	55,340	27,015	7,584
65	Experiment Station Work—II.....	20,235	12,009	8,505
66	Meadows and Pastures.....	50,475	25,678	5,523
67	Forestry for Farmers.....	25,400	8,533	4,461
68	The Black Rot of the Cabbage.....	20,040	14,849	3,789
69	Experiment Station Work—III.....	20,400	8,715	7,160
70	The Principal Insect Enemies of the Grape.....	15,400	12,947	3,819
71	Some Essentials of Beef Production.....	22,310	22,310	3,820
72	Cattle Ranges of the Southwest.....	10,200	5,099	2,788
73	Experiment Station Work—IV.....	40,650	14,395	14,390
74	Milk as Food.....	32,550	15,102	17,704
75	The Grain Smuts.....	20,250	13,228	6,245
76	Tomato Growing.....	46,775	21,149	14,834
77	The Liming of Soils.....	20,250	12,255	8,253
78	Experiment Station Work—V.....	25,260	11,589	11,107
79	Experiment Station Work—VI.....	35,130	14,286	16,910
80	The Peach Twig-borer—an Important Enemy of Stone Fruits.....	20,180	7,278	7,547
81	Corn Culture in the South.....	40,775	23,018	8,291
82	The Culture of Tobacco.....	51,300	27,641	9,186
83	Tobacco Soils.....	30,350	6,409	6,492
84	Experiment Station Work—VII.....	35,395	9,639	15,782
85	Fish as Food.....	30,425	7,194	13,801
86	Thirty Poisonous Plants.....	50,250	11,781	18,855
87	Experiment Station Work—VIII.....	30,050	4,052	21,823
88	Alkali Lands.....	30,100	3,400	15,157
89	Cowpeas.....	30,000	4,956	12,699
90	The Manufacture of Sorghum Sirup.....	25,000	794	4,652
91	Potato Diseases and Their Treatment.....	30,000	594	9,831
92	Experiment Station Work—IX.....	30,000	2,101	18,472
93	Sugar as Food.....	20,000	720	4,823
94	The Vegetable Garden.....	30,000	2,016	4,330
95	Good Roads for Farmers.....	29,000	322	3,469
96	Raising Sheep for Mutton.....	30,135	61	1,347
97	Experiment Station Work—X.....	20,000	61	1,447
98	Suggestions to Southern Farmers.....	20,400	-----	1,281
99	Three Insect Enemies of Shade Trees.....	20,100	61	1,551
100	Hog Raising in the South.....	30,185	-----	-----
Total.....		2,488,340	1,096,335	680,775
Total aggregate distribution.....		-----	-----	1,777,110

Publications received and distributed by the Weather Bureau during the year ended June 30, 1899, by quarters.

Number and title of publication.	Number of copies.
QUARTER ENDED SEPTEMBER 30, 1898.	
<i>Received.</i>	
No. 167. Instructions for Obtaining and Tabulating Records from Recording Instruments (Circular A, Instrument Division).....	600
No. 168. Investigation of the Cyclonic Circulation and the Translatory Movement of West Indian Hurricanes.....	1,000
No. 169. Monthly Bulletin of the River and Flood Service for June, 1898.....	650
No. 170. Monthly Weather Review for May, 1898.....	4,000
No. 171. Moisture Tables.....	500
No. 172. Monthly Weather Review for June, 1898.....	4,000
No. 173. Monthly Bulletin of the River and Flood Service for July, 1898.....	650
No. 174. Monthly Weather Review for July, 1898.....	4,000
No. 175. Monthly Bulletin of the River and Flood Service for August, 1898.....	650
Washington Daily Weather Maps.....	78,470
Climate and Crop Bulletins.....	52,078
Meteorological Chart of the Great Lakes.....	9,000
Rainfall in Nicaragua (reprint from the Monthly Weather Review for April and July, 1898).....	100
<i>Distributed.</i>	
Annual Report of the Chief of the Weather Bureau for 1891-92.....	6
Annual Report of the Chief of the Weather Bureau for 1893.....	8
Annual Report of the Chief of the Weather Bureau for 1894.....	7
Annual Report of the Chief of the Weather Bureau for 1895-96.....	43
Annual Report of the Chief of the Weather Bureau for 1896-97.....	603
Description of Cloud Forms.....	822
Certain Climatic Features of the Two Dakotas.....	3
Extracts from the Annual Report of the Chief of the Weather Bureau for 1891-92.....	25
Extracts from the Annual Report of the Chief of the Weather Bureau for 1895-96.....	19
Extracts from the Annual Report of the Chief of the Weather Bureau for 1896-97.....	35
Irrigation and Water Storage in the Arid Regions.....	7
Monthly Weather Reviews (various months and years).....	868
Protection from Lightning (Circular).....	46
Pamphlet Report of the Weather Bureau for 1892, 1893, 1895, and 1896.....	4
Bulletin A.....	2
Bulletin B.....	5
Bulletin C.....	6
Bulletin D.....	27
Bulletin E.....	4
Bulletin No. 10.....	1
Bulletin No. 11, Part III.....	18
Bulletin No. 12.....	13
Bulletin No. 14.....	15
Bulletin No. 16.....	16
Bulletin No. 18.....	11
Bulletin No. 19.....	13
Bulletin No. 21.....	12
Bulletin No. 22.....	108
Climate and Health.....	22
Weather Types and Storms.....	13
No. 167. Instructions for Obtaining and Tabulating Records from Recording Instruments (Circular A, Instrument Division).....	800
No. 168. Investigation of the Cyclonic Circulation and the Translatory Movement of West Indian Hurricanes.....	677
No. 169. Monthly Bulletin of the River and Flood Service for June, 1898.....	650
No. 170. Monthly Weather Review for May, 1898.....	3,900
No. 171. Moisture Tables.....	500
No. 172. Monthly Weather Review for June, 1898.....	3,838
No. 173. Monthly Bulletin of the River and Flood Service for July, 1898.....	650
No. 174. Monthly Weather Review for July, 1898.....	3,868
No. 175. Monthly Bulletin of the River and Flood Service for August, 1898.....	650
Washington Daily Weather Maps.....	77,550
Climate and Crop Bulletins.....	52,078
Meteorological Chart of the Great Lakes.....	9,000
Rainfall in Nicaragua (reprint from the Monthly Weather Review for April and July, 1898).....	100
QUARTER ENDED DECEMBER 31, 1898.	
<i>Received.</i>	
No. 176. Monthly Weather Review for August, 1898.....	4,000
No. 177. Monthly Bulletin of the River and Flood Service for September, 1898.....	650
No. 178. Monthly Weather Review for September, 1898.....	4,100
No. 179. The Probable State of the Sky along the Path of Total Eclipse of the Sun, May 28, 1900.....	300
No. 180. Aneroid Barometers.....	250
No. 181. Pamphlet Report of the Chief of the Weather Bureau for 1898.....	5,000

Publications received and distributed by the Weather Bureau during the year ended June 30, 1899, by quarters—Continued.

Number and title of publication.	Number of copies.
QUARTER ENDED DECEMBER 31, 1898—continued.	
<i>Received—Continued.</i>	
No. 182. Monthly Bulletin of the River and Flood Service for October, 1898.....	650
No. 183. Monthly Weather Review for October, 1898.....	4,200
Description of Cloud Forms (fourth edition).....	5,000
Bound Monthly Weather Reviews for 1897.....	164
Washington Daily Weather Maps.....	96,720
Climate and Crop Bulletin.....	8,174
Snow and Ice Chart.....	6,760
Meteorological Chart of the Great Lakes.....	8,200
<i>Distributed.</i>	
Annual Report of the Chief of the Weather Bureau for 1893.....	10
Annual Report of the Chief of the Weather Bureau for 1894.....	12
Annual Report of the Chief of the Weather Bureau for 1895-96.....	13
Annual Report of the Chief of the Weather Bureau for 1896-97.....	66
Extracts from the Annual Report of the Chief of the Weather Bureau for 1891-92.....	193
Extracts from the Annual Report of the Chief of the Weather Bureau for 1893.....	5
Extracts from the Annual Report of the Chief of the Weather Bureau for 1894.....	10
Extracts from the Annual Report of the Chief of the Weather Bureau for 1895-96.....	27
Extracts from the Annual Report of the Chief of the Weather Bureau for 1896-97.....	70
What Meteorology is Doing for the Farmer.....	217
Climate and Health (bound).....	13
Climate and Health (bound in paper).....	13
Monthly Weather Review (various months).....	244
Climate of the Two Dakotas.....	2
Description of Cloud Forms.....	210
Bulletin A.....	13
Bulletin B.....	11
Bulletin C.....	22
Bulletin D.....	27
Bulletin E.....	9
Bulletin No. II, Part III.....	136
Bulletin No. 12.....	22
Bulletin No. 14.....	21
Bulletin No. 15 (lightning circular).....	38
Bulletin No. 16.....	477
Bulletin No. 18.....	144
Bulletin No. 19.....	12
Bulletin No. 21.....	18
Bulletin No. 22.....	381
Bulletin No. 108.....	12
Report of the Chief of the Weather Bureau for 1892, 1893, 1895, 1896 and 1897 (pamphlet).....	543
Bound Monthly Weather Reviews for 1897.....	164
No. 176. Monthly Weather Review for August, 1898.....	3,945
No. 177. Monthly Bulletin of the River and Flood Service for September, 1898.....	650
No. 178. Monthly Weather Review for September, 1898.....	4,035
No. 179. The Probable State of the Sky along the Path of Total Eclipse of the Sun, May 28, 1900.....	300
No. 180. Aneroid Barometers.....	250
No. 181. Report of the Chief of the Weather Bureau for 1898 (pamphlet).....	4,800
No. 182. Monthly Bulletin of the River and Flood Service for October, 1898.....	650
No. 183. Monthly Weather Review for October, 1898.....	4,042
Monthly Weather Reviews for 1897 (bound).....	164
Washington Daily Weather Maps.....	95,800
Climate and Crop Bulletin.....	8,160
Snow and Ice Chart.....	6,760
Meteorological Chart of the Great Lakes.....	8,200
QUARTER ENDED MARCH 31, 1899.	
<i>Received.</i>	
No. 179. The Probable State of the Sky along the Path of Total Eclipse of the Sun, May 28, 1900 (second reprint).....	300
No. 184. Instructions for Voluntary Observers, 1899.....	5,000
No. 185. Monthly Weather Review for November, 1898.....	4,200
No. 186. Frost: When to Expect It and How to Lessen the Injury Therefrom, 1899 (Bulletin No. 23).....	5,000
No. 188. Climate and Crop Report, Season of 1898, Alaska Section.....	300
No. 189. Monthly Weather Review for December, 1898.....	4,200
No. 190. Monthly Weather Review, Annual Summary for 1898.....	4,200
No. 192. Monthly Weather Review for January, 1899.....	4,200
Washington Daily Weather Maps.....	119,100
Climate and Crop Bulletins.....	12,236
Snow and Ice Charts.....	23,250

Publications received and distributed by the Weather Bureau during the year ended June 30, 1899, by quarters—Continued.

Number and title of publication.	Number of copies.
QUARTER ENDED MARCH 31, 1899—continued.	
<i>Distributed.</i>	
Annual Report of the Chief of the Weather Bureau for 1893	9
Annual Report of the Chief of the Weather Bureau for 1894	9
Annual Report of the Chief of the Weather Bureau for 1895-96	9
Annual Report of the Chief of the Weather Bureau for 1896-97	39
Extracts from the Annual Report of the Chief of the Weather Bureau for 1891-92	205
Extracts from the Annual Report of the Chief of the Weather Bureau for 1895-96	38
Extracts from the Annual Report of the Chief of the Weather Bureau for 1896-97	108
Monthly Weather Reviews (various months)	205
Description of Cloud Forms (fourth edition)	702
Bulletin A	3
Bulletin B	1
Bulletin C	7
Bulletin D	18
Bulletin E	6
Bulletin No. 12	2
Bulletin No. 13	3
Bulletin No. 14	4
Bulletin No. 15 (lightning circular)	135
Bulletin No. 16	4
Bulletin No. 18	2
Bulletin No. 19	1
Bulletin No. 21	1
Bulletin No. 22	57
Reports of the Chief of the Weather Bureau for 1892, 1893, 1895, 1896, and 1897 (pamphlet)	37
No. 168. Investigation of the Cyclonic Circulation and the Translatory Movement of West Indian Hurricanes	54
No. 181. Report of the Chief of the Weather Bureau for 1898 (pamphlet)	24
No. 179. The Probable State of the Sky along the Path of Total Eclipse of the Sun, May 28, 1900 (second reprint)	300
No. 184. Instructions for Voluntary Observers, 1899	5,000
No. 185. Monthly Weather Review for November, 1898	4,035
No. 186. Frost: When to Expect It and How to Lessen the Injury Therefrom, 1899 (Bulletin No. 23)	4,250
No. 188. Climate and Crop Report. Season of 1898, Alaska Section	7
No. 189. Monthly Weather Review for December, 1898	4,025
No. 190. Monthly Weather Review, Annual Summary for 1898	4,025
No. 192. Monthly Weather Review for January, 1899	4,035
Washington Daily Weather Maps	118,210
Climate and Crop Bulletins	12,206
Snow and Ice Charts	23,250
QUARTER ENDED JUNE 30, 1899.	
<i>Received.</i>	
No. 187. Proceedings of the Convention of Weather Bureau Officials held at Omaha, Nebr., October 13 and 14, 1898 (Bulletin No. 24)	5,000
No. 191. Weather Forecasting: Some Facts Historical, Practical, and Theoretical (Bulletin No. 25)	5,000
No. 193. Measurement of Precipitation (Circular E, Instrument Division)	750
No. 194. Hydrology of the Lake Minnetonka Watershed	750
No. 195. Monthly Weather Review for February, 1899	4,000
No. 196. Monthly Weather Review for March, 1899	4,000
No. 197. Lightning and the Electricity of the Air. In two parts (Bulletin No. 26)	5,000
No. 198. Monthly Weather Review for April, 1899	4,000
Washington Daily Weather Maps	126,150
Climate and Crop Bulletins	52,926
Meteorological Charts of the Great Lakes	8,000
Report of the Chief of the Weather Bureau for 1897-98	1,000
Part II. Report of the Chief of the Weather Bureau for 1897-98	250
Part III. Report of the Chief of the Weather Bureau for 1897-98	500
Part IV. Report of the Chief of the Weather Bureau for 1897-98	250
Part V. Report of the Chief of the Weather Bureau for 1897-98	250
Part VI. Report of the Chief of the Weather Bureau for 1897-98	500
Part VII. Report of the Chief of the Weather Bureau for 1897-98	250
<i>Distributed.</i>	
Annual Report of the Chief of the Weather Bureau for 1893	2
Annual Report of the Chief of the Weather Bureau for 1894	1
Annual Report of the Chief of the Weather Bureau for 1895-96	5
Annual Report of the Chief of the Weather Bureau for 1896-97	4
Annual Report of the Chief of the Weather Bureau for 1897-98	858
Extracts from the Annual Report of the Chief of the Weather Bureau for 1891-92	67
Extracts from the Annual Report of the Chief of the Weather Bureau for 1895-96	23
Extracts from the Annual Report of the Chief of the Weather Bureau for 1896-97	30
Extracts from the Annual Report of the Chief of the Weather Bureau for 1897-98	225

Publications received and distributed by the Weather Bureau during the year ended June 30, 1899, by quarters—Continued.

Number and title of publication.	Number of copies.
QUARTER ENDED JUNE 30, 1899—continued.	
<i>Distributed—Continued.</i>	
Monthly Weather Reviews (various months)	36
Description of Cloud Forms	88
Bulletin C	2
Bulletin D	21
Bulletin E	4
Bulletin No. 11 (Part III)	4
Bulletin No. 12	4
Bulletin No. 13	1
Bulletin No. 15 (lightning circular)	153
Bulletin No. 19	5
Bulletin No. 21	1
Bulletin No. 22	7
Reports of the Chief of the Weather Bureau, 1892, 1893, 1895, 1896, 1897, and 1898 (pamphlets)	15
No. 168. Investigation of the Cyclonic Circulation and the Translatory Movement of West Indian Hurricanes	18
No. 179. The Probable State of the Sky along the Path of Total Eclipse of the Sun, May 28, 1900	12
No. 186. Frost: When to Expect It and How to Lessen the Injury Therefrom (Bulletin No. 23)	400
No. 187. Proceedings of the Convention of Weather Bureau Officials held at Omaha, Nebr., October 13-14, 1898 (Bulletin No. 24)	5,000
No. 191. Weather Forecasting: Some Facts Historical, Practical, and Theoretical (Bul- letin No. 25)	3,500
No. 193. Measurement of Precipitation (Circular E, Instrument Division)	750
No. 194. Hydrology of the Lake Minnetonka Watershed	676
No. 195. Monthly Weather Review for February, 1899	3,940
No. 196. Monthly Weather Review for March, 1899	3,943
No. 197. Lightning and Electricity of the Air, in two parts (Bulletin No. 26)	2,000
No. 198. Monthly Weather Review for April, 1899	3,945
Washington Daily Weather Maps	125,250
Climate and Crop Bulletins	52,926
Meteorological Charts of the Great Lakes	8,000

REPORT OF THE LIBRARIAN.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE LIBRARIAN,
Washington, D. C., June 30, 1899.

SIR: I have the honor to submit the following statement in response to your order of June 27, 1899, calling for my executive report for the fiscal year ending this day.

Respectfully,

W. P. CUTTER,
Librarian.

Hon. JAMES WILSON, *Secretary.*

WORK OF THE YEAR.

ADDITIONS TO THE LIBRARY.

The additions to the Library during the past year have numbered about 4,000 volumes, including some very rare works and scarce sets of periodicals. A special attempt has been made during the year to complete sets of periodicals and publications of learned societies and official bodies in connection with a catalogue of these works which is in process of preparation, and much progress has been made in this line.

REPAIRS TO THE LIBRARY ROOM.

Necessary repairs to the room in which the Library is located required the storing of the major part of the collection of books, so that for about six weeks the main portion of the Library was inaccessible. The whole Library was removed from this room and replaced after repairs were made without loss of books, and with very little misplacing of them. The routine work of cataloguing and caring for the books received was not interrupted in the least. The comparatively slight interruption to work was entirely due to the accurate classification and numbering of the books on the shelves and to a special method, devised by the Librarian, of labeling the parcels of books, which was found to work very well with ordinary day labor under proper supervision.

THE PERIODICAL LIST.

The periodical list of the Library is growing very fast, owing to the efforts being made to increase our exchange relations with publishing societies and officials of the various countries. There are currently received by the Library at present nearly 2,500 periodical publications, more than 1,800 being received by way of exchange or gift. The care of this mass of literature is becoming more and more a serious problem with the limited room at the disposal of the Library.

CATALOGUES.

The card catalogue, during the four-and-a-half years since its inception, has grown in bulk enormously. There are more than 50,000 cards

in the catalogue, covering in author and subject entries more than two-thirds of the books in the Library. The publication of a catalogue of the books on forestry has shown that the collection on this subject is extremely full, having undoubtedly more than three times the extent of any similar collection in this country. Catalogues of the books on botany and of the books on chemistry are well advanced and will probably be published before the end of the next year. The preparation of a catalogue of the periodical publications is also progressing, and I trust will be completed by the end of the year.

There is also in progress a complete author and subject catalogue of the publications of the Department of Agriculture since 1839, with such analytical entries as will bring out the subjects of separate papers in such publications as the Yearbook and the Farmers' Bulletins. A card issue of this catalogue is in contemplation, to be distributed to the libraries of the agricultural colleges and such other institutions as have sets of our publications. By the incorporation of these cards into the existing card catalogues of the above institutions the publications of the Department will be more frequently brought to notice and be made much more available.

DUTIES OF THE LIBRARIAN.

In addition to the work of the Library, the Librarian is charged with the supervision of the translations for the Department, with the distribution of press clippings and the indexing of farm papers, and with the exchange of publications with correspondents in this country and abroad. The plan devised for exchange service is working well in so far as the shipment of publications is concerned, but there is need of unification of effort in the combining of the various divisional lists in such a way as to insure that several prominent institutions in each country have a complete set of our publications. A revision of the lists with this end in view has been undertaken. I am happy to say that the publications of the Department are attracting great attention among the learned men of foreign countries, and the demand for them is increasing. Such confusion exists as a result of the changes in names of divisions and the bewildering classification of our publications that it is becoming more and more difficult to find any particular publication or even to so arrange and catalogue the heterogeneous mass as to insure complete sets. I would strongly urge an immediate attempt to segregate these various publications into fewer series, in order that our published scientific results may not be entirely lost in the future.

RECOMMENDATION.

The appropriation for the Library was unfortunately reduced for the fiscal year ending June 30, 1900, which action will, I fear, seriously embarrass the work of the Department in various ways. It is important that scientific investigators should be provided with all the records of contemporary scientific work elsewhere in order that their own work of investigation may be intelligently carried on, and any diminution of the amount appropriated for purchasing these records is likely to result in difficulty for the scientific worker. It is sincerely hoped that the importance of this matter to the whole Department will impress itself on Congress, and I earnestly recommend that the appropriation for support of the Library be restored to \$7,000.

REPORT OF THE CHIEF OF THE DIVISION OF ACCOUNTS AND DISBURSEMENTS.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF ACCOUNTS AND DISBURSEMENTS,
Washington, D. C., July 25, 1899.

SIR: I have the honor to submit herewith a brief report of the work of this Division for the fiscal year ending June 30, 1899.

Respectfully,

F. L. EVANS,
Chief.

Hon. JAMES WILSON, *Secretary.*

WORK OF THE YEAR.

APPROPRIATIONS AND EXPENDITURES.

For the fiscal year ending June 30, 1899, Congress appropriated to the United States Department of Agriculture the sum of \$2,829,702, exceeding the appropriations of the preceding year by \$361,800. By the same act the usual amount of \$720,000 was provided for the forty-eight agricultural experiment stations.

Of the former sum, \$2,622,879.57 was expended prior to July 1, 1899, leaving outstanding liabilities amounting to about \$185,000. The total expenditures for the year, including the payment of supplemental accounts for the years 1897 and 1898, amounted to \$2,797,173.49.

The unexpended balances of the appropriations for the year ending June 30, 1897, were carried to the surplus fund and covered into the Treasury on June 30, 1899, as provided by law, amounting to \$100,019.02. The balances of the appropriations for 1898 will be finally covered into the Treasury June 30, 1900.

During the year 17,001 accounts were received, audited, and paid, as follows, including bond-aided and supplemental accounts for the two preceding years: Divisional, 4,900, amounting to \$887,294.08; Bureau of Animal Industry, 3,317, amounting to \$874,763.62; Weather Bureau, 8,784, amounting to \$1,035,115.79. In payment of these accounts 28,689 checks were drawn on the Treasury at Washington and sub-treasuries at New York and Chicago.

The expense for telegraph and telephone service for the Weather Bureau during the year amounted to \$165,000.

The following table shows in detail the objects of the several appropriations for 1899, the amounts disbursed during the year, and the unexpended balances on June 30, 1899:

Appropriations, disbursements, and amount unexpended for the fiscal year 1899.

Object.	Appropriations, 1899.	Amount disbursed.	Amount unexpended.
Salaries, officers and clerks.....	\$319,300.00	\$315,965.93	\$3,334.07
Furniture, cases, and repairs.....	9,000.00	8,522.91	477.09
Library.....	6,000.00	3,346.69	2,653.31
Museum.....	1,500.00	1,465.36	34.64
Postage.....	2,000.00	2,000.00	-----
Contingent expenses.....	25,000.00	22,139.43	2,860.57
Animal quarantine stations.....	12,000.00	10,252.16	1,747.84
Collecting agricultural statistics.....	105,000.00	98,237.91	6,762.09
Botanical investigations and experiments.....	20,000.00	18,389.65	1,610.35
Entomological investigations.....	20,000.00	18,936.57	1,063.43
Vegetable pathological investigations.....	20,000.00	18,081.82	1,918.18
Biological investigations.....	17,500.00	14,496.14	3,003.86
Pomological investigations.....	9,500.00	7,874.47	1,625.53
Laboratory.....	12,400.00	10,544.44	1,855.56
Forestry investigations.....	20,000.00	15,777.67	4,222.33
Experimental gardens and grounds.....	20,000.00	19,480.64	519.36
Soil investigations.....	10,000.00	9,340.22	659.78
Grass and forage plant investigations.....	10,000.00	9,080.24	919.76
Irrigation information.....	10,000.00	6,972.16	3,027.84
Agricultural experiment stations [\$760,000] <i>a</i>	40,000.00	36,662.55	3,337.45
Nutrition investigations.....	15,000.00	13,469.31	1,530.69
Public road inquiries.....	8,000.00	7,203.34	796.66
Publications, Farmers' Bulletins.....	65,000.00	61,276.25	3,723.75
Purchase and distribution of valuable seeds.....	130,000.00	116,015.59	13,984.41
Investigating production of domestic sugar.....	7,000.00	6,358.36	641.64
Salaries and expenses, Bureau of Animal Industry.....	900,000.00	866,624.87	33,375.13
Total.....	1,814,200.00	1,718,514.68	95,685.32
WEATHER BUREAU.			
Salaries.....	153,340.00	152,597.83	742.17
Fuel, lights, and repairs.....	8,000.00	7,299.07	700.93
Contingent expenses.....	8,000.00	6,717.54	1,282.46
General expenses.....	765,162.00	665,945.90	99,216.10
Repairs to buildings and grounds, Bismarck, N. Dak.....	3,000.00	2,504.10	495.90
Erection of building at Sault Ste. Marie, Mich.....	3,000.00	1,494.12	1,505.88
Meteorological observation stations.....	75,000.00	67,806.33	7,193.67
Total, Weather Bureau.....	937,502.00	904,364.89	111,137.11
Grand total.....	2,829,702.00	2,622,879.57	206,822.43

a Of this amount, \$720,000 is paid directly to the experiment stations from the Treasury Department.

The appropriations for the year 1900, aggregating \$3,006,032, carry a total increase over the appropriations for the year 1899 of \$176,320. This increase is shown in the following table, which gives in detail the appropriations for the years 1899 and 1900:

Appropriations for the years 1899 and 1900.

Object.	Amount appropriated for 1899.	Amount appropriated for 1900.
Salaries, officers and clerks.....	\$319,300.00	\$336,340.00
Furniture, cases, and repairs.....	9,000.00	10,000.00
Library.....	6,000.00	5,000.00
Museum.....	1,500.00	1,500.00
Postage.....	2,000.00	2,000.00
Contingent expenses.....	25,000.00	25,000.00
Animal quarantine stations.....	12,000.00	12,000.00
Collecting agricultural statistics.....	105,000.00	110,000.00
Botanical investigations and experiments.....	20,000.00	20,000.00
Entomological investigations.....	20,000.00	20,000.00
Vegetable pathological investigations.....	20,000.00	26,000.00

Appropriations for the years 1899 and 1900—Continued.

Object.	Amount ap- propriated for 1899.	Amount ap- propriated for 1900.
Biological investigations.....	\$17,500.00	\$17,500.00
Pomological investigations.....	9,500.00	9,500.00
Laboratory.....	12,400.00	17,700.00
Forestry investigations.....	20,000.00	40,000.00
Experimental gardens and grounds.....	20,000.00	28,000.00
Soil investigations.....	10,000.00	20,000.00
Grass and forage plant investigations.....	10,000.00	12,000.00
Irrigation information.....	10,000.00	35,000.00
Agricultural experiment stations.....	a 40,000.00	45,000.00
Nutrition investigations.....	15,000.00	15,000.00
Public road inquiries.....	8,000.00	8,000.00
Publications, Farmers' Bulletins.....	65,000.00	80,000.00
Purchase and distribution of valuable seeds.....	130,000.00	130,000.00
Investigating production of domestic sugar.....	7,000.00	7,000.00
Tea-culture investigations.....	1,000.00	1,000.00
Salaries and expenses, Bureau of Animal Industry.....	900,000.00	950,000.00
Total.....	1,814,200.00	1,983,540.00
WEATHER BUREAU.		
Salaries.....	153,340.00	153,320.00
Fuel, lights, and repairs.....	8,000.00	8,000.00
Contingent expenses.....	8,000.00	8,000.00
General expenses.....	765,162.00	768,162.00
Meteorological observation stations.....	75,000.00	60,000.00
Erection of building at Sault Ste. Marie, Mich.....	3,000.00	.....
Repairs to buildings and grounds, Bismarck, N. Dak.....	3,000.00	.....
Additions to Annex Building, Weather Bureau, Washington, D. C.....	.....	25,000.00
Total, Weather Bureau.....	1,015,502.00	1,022,482.00
Grand total.....	2,829,702.00	3,006,022.00

a The total appropriations under this head are \$760,000 and \$765,000 for the years given, respectively, but \$720,000 of each appropriation is paid directly to the experiment stations from the Treasury Department. The sums included in the figure columns represent only the amount available for departmental expenditures.

The following is a statement of all appropriations made to the United States Department of Agriculture, the original and last date of the act making the appropriation, the amount of the first appropriation, and the total amount appropriated for each object to and including the fiscal year 1900:

Appropriations from 1840 to 1900, inclusive, by objects.

Object.	Date of original appropriation act.	Reference to Statutes at Large.			Date of last appropriation act.	Amount of original appropriation.	Total amount appropriated to June 30, 1900.
		Vol.	Page.	Sec.			
Collection of agricultural statistics, etc.....	Mar. 3, 1839	5	354	9	Mar. 1, 1899	\$1,000.00	\$2,577,500.00
Chemical analyses of vegetable substances.....	Aug. 12, 1848	9	285	1	Mar. 3, 1849	1,000.00	2,000.00
Information in relation to consumption of cotton.....	Mar. 3, 1857	11	226	1	Mar. 3, 1857	3,500.00	3,500.00
Salaries (Commissioner, \$3,000; Chief Clerk, \$2,000).....	Feb. 25, 1863	12	691	1	Mar. 1, 1899	5,000.00	5,127,850.00
Culture of cotton and tobacco.....	.....do.....	12	691	1	Feb. 25, 1863	3,000.00	3,000.00
Investigations with flax and hemp.....	.....do.....	12	691	1	.....do.....	20,000.00	20,000.00
Purchase of sorghum seed.....	Mar. 14, 1864	13	23	1	Mar. 14, 1864	2,000.00	2,000.00
To rebuild shop in propagating garden.....	.....do.....	13	23	1	.....do.....	800.00	800.00
Postage.....	.....do.....	13	23	1	Mar. 1, 1899	1,320.00	250,320.00
Furniture, carpets, fuel, etc.....	.....do.....	13	23	1	June 25, 1864	650.00	1,450.00
Contingent expenses.....	June 25, 1864	13	155	1	Mar. 1, 1899	3,500.00	575,400.00
Library and laboratory.....	.....do.....	13	155	1	June 25, 1864	4,000.00	4,000.00
Purchase and distribution of seeds.....	.....do.....	13	155	1	Mar. 1, 1899	61,000.00	3,377,526.21

Appropriations from 1840 to 1900, inclusive, by objects—Continued.

Object.	Date of original appropriation act.	Reference to Statutes at Large.			Date of last appropriation act.	Amount of original appropriation.	Total amount appropriated to June 30, 1900.
		Vol.	Page.	Sec.			
Experimental gardens and grounds.....	June 25, 1864	13	155	1	Mar. 1, 1899	\$15,800.00	\$875,786.24
To pay a debt incurred in preparing Agricultural Report for 1861.....	July 2, 1864	13	350	2	July 2, 1864	3,704.05	3,704.05
Rent, etc., of Commissioner's office.....	July 4, 1864	13	381	3	July 4, 1864	3,500.00	3,500.00
Purchase of the Glover Museum.....	Mar. 2, 1867	14	452	1	Mar. 2, 1867	10,000.00	10,000.00
To erect a building for the Department of Agriculture.....	.....do.....	14	464	1	.....do.....	100,000.00	100,000.00
For certain goods and services furnished the Department.....	July 13, 1868	15	90	1	July 13, 1868	37,604.70	37,604.70
Furniture, cases, and repairs.....	July 20, 1868	15	106	1	Mar. 1, 1899	22,635.00	233,960.00
Investigations of cattle diseases; also diseases of domestic animals.....	Mar. 3, 1869	15	298	1	Jan. 20, 1883	15,000.00	120,000.00
Collecting and modeling specimens of fruit.....	July 12, 1870	16	246	1	Mar. 3, 1871	1,000.00	2,000.00
Library.....	.....do.....	16	246	1	Mar. 1, 1899	1,000.00	78,550.00
Herbarium.....	.....do.....	16	246	1	Mar. 3, 1871	1,000.00	2,000.00
Laboratory.....	.....do.....	16	246	1	Mar. 1, 1899	1,700.00	218,350.00
Folding room; also document and folding room.....	.....do.....	16	246	1	Mar. 2, 1895	500.00	12,800.00
Museum and Herbarium.....	May 8, 1872 June 10, 1872	17 17	78 369	1	Mar. 1, 1899	5,000.00	60,000.00
To publish Commissioner's report for the years 1872 and 1873.....	June 23, 1874	18	227	1	June 23, 1874	50,000.00	50,000.00
Report on forestry; also forestry investigations.....	Mar. 3, 1877	19	360	1	Mar. 1, 1899	2,500.00	266,556.85
International Industrial Exposition at Paris.....	Dec. 15, 1877	20	246	4	Dec. 15, 1877	10,000.00	10,000.00
Investigating the history and habits of insects; also entomological investigations.....	June 19, 1878	20	204	1	Mar. 1, 1899	10,000.00	413,932.48
To erect a stable.....	Mar. 3, 1879	20	392	1	Mar. 3, 1879	1,500.00	1,500.00
Examination of fibers: fiber investigations.....	June 16, 1880	21	295	1	Apr. 23, 1897	4,000.00	59,000.00
Experiments in the manufacture of sugar.....	.....do.....	21	295	1	Mar. 1, 1899	7,500.00	531,362.93
Collecting data touching arid regions of the United States.....	.....do.....	21	295	1	Mar. 3, 1881	5,000.00	10,000.00
Reclamation of arid lands.....	.....do.....	21	295	1	June 30, 1886	20,000.00	65,000.00
Experiments in the culture, etc., of tea.....	Mar. 3, 1881	21	383	1	Mar. 1, 1899	10,000.00	24,000.00
Building for the display of agricultural implements.....	.....do.....	21	385	1	Mar. 3, 1881	10,000.00	10,000.00
Transportation of specimens from Atlanta.....	Feb. 13, 1882	22	3	1	Feb. 13, 1882	5,000.00	5,000.00
Erection of building for Seed Division.....	Aug. 7, 1882	22	306	1	Aug. 7, 1882	25,000.00	25,000.00
Report on the Angora goat.....	.....do.....	22	337	1	.....do.....	500.00	500.00
Laboratory, and for experiments in the manufacture of sugar.....	Jan. 20, 1883	22	410	1	Mar. 3, 1885	16,842.18	106,842.18
Building of greenhouse.....	.....do.....	22	631	1	Jan. 20, 1883	2,500.00	2,500.00
Bureau of Animal Industry.....	May 29, 1884	23	31	1	Mar. 1, 1899	150,000.00	9,275,000.00
Silk culture.....	June 5, 1884	23	39	1	July 14, 1890	15,000.00	128,341.69
Quarantine stations for neat cattle; also animal quarantine stations.....	July 7, 1884	23	207	1	Mar. 1, 1899	25,000.00	267,000.00
Pomological information; also pomological investigations.....	June 30, 1886	24	100	1	.....do.....	3,000.00	78,329.27
Botanical investigations; also botanical investigations and experiments.....	.....do.....	24	100	1	.....do.....	5,000.00	344,832.40
Investigations in ornithology and mammalogy; also Biological Survey.....	.....do.....	24	101	1	.....do.....	10,000.00	192,470.80
Adulteration of food.....	.....do.....	24	101	1	Mar. 3, 1887	1,000.00	2,000.00
Microscopical investigations.....	July 18, 1888	25	330	1	Mar. 2, 1895	1,000.00	17,062.50
Agricultural experiment stations.....	.....do.....	25	334	1	Mar. 1, 1899	10,000.00	305,223.50
Artesian wells.....	Apr. 4, 1890	26	42	1	Apr. 4, 1890	20,000.00	20,000.00

Appropriations from 1840 to 1900, inclusive, by objects—Continued.

Object.	Date of original appropriation act.	Reference to Statutes at Large.			Date of last appropriation act.	Amount of original appropriation.	Total amount appropriated to June 30, 1900.
		Vol.	Page.	Sec.			
Vegetable pathological investigations; also vegetable physiology and pathology	July 14, 1890	26	285	1	Mar. 1, 1899	\$15,000.00	\$190,076.47
Illustrations and engravings	do	26	286	1	Mar. 2, 1895	2,000.00	38,000.00
Irrigation investigations	Sept. 30, 1890	26	525	1	Mar. 1, 1899	40,000.00	118,000.00
Weather Bureau	Mar. 3, 1891	26	1051	1	do	889,753.50	8,324,045.81
Experiments in the production of rainfall	July 5, 1892	27	76	1	July 5, 1892	10,000.00	10,000.00
Inquiries relating to public roads	Mar. 3, 1893	27	737	1	Mar. 1, 1899	10,000.00	62,000.00
Nutrition investigations	Aug. 18, 1894	28	271	1	do	10,000.00	85,000.00
Grass and forage plant investigations	Mar. 2, 1895	28	735	1	do	15,000.00	67,000.00
Soil investigations	do	28	735	1	do	15,000.00	65,000.00
Publications	Apr. 25, 1896	29	104	1	do	70,000.00	280,000.00
Investigating production of domestic sugar	Apr. 23, 1897				do	5,000.00	19,000.00

REQUISITIONS, LETTERS, AND REQUESTS.

One hundred and two requisitions were drawn on the United States Treasury for amounts aggregating \$2,797,173.49, in settlement of all claims against the Department presented during the year.

During the same period 6,310 requisitions were issued for the purchase of general supplies.

There were issued 1,075 letters of authority for traveling and certain other expenses.

In the transaction of the regular business of the Division 33,516 letters were written and received.

For the transportation of Government property 1,722 requests were drawn on the Quartermaster-General.

There were 2,254 requests for passenger transportation issued to officers and agents of the Department traveling on official business. Reference was made in the report of the chief of this Division for 1898 to the fact that a new form of "request" for passenger transportation had been designed and adopted for the use of the several Executive Departments. This form has received the approval of the Comptroller of the Treasury and is now in general use. The request is engraved on bond paper and is artistic in design; is of a sensitive shade, making any change on the face of the request, for fraudulent purposes, most difficult. Each Department has its distinctive color, that of the Department of Agriculture being of a light shade of blue. This uniformity in the details of the Government-transportation request will enable traveling agents of the Government to have their requests readily accepted by all railroad and steamboat ticket agents in any part of the country. Prior to the adoption of the new form, officers of the Government occasionally experienced some difficulty in this regard in small towns and remote sections, because of the entire absence of uniformity in general details of the forms in use by the several Departments and the insufficiency of evidence as to their official character and authority. The first request of the new series was issued by this Department on April 1, 1899.

MONEYS RECEIVED FROM CONDEMNED PROPERTY AND OTHER SOURCES.

During the year \$33,691.29 was received in this office from various sources and deposited in the United States Treasury, 'as follows:

Condemned property	\$2,776.25
Card index	84.00
Publications, Weather Bureau	82.68
United States seacoast-telegraph receipts	3,869.94
Sale of American butter in Europe	26,878.42
Total	33,691.29

The amount received from the sale of American butter in Europe was deposited to the credit of the appropriation for "Salaries and expenses, Bureau of Animal Industry, 1899," as required by the appropriation act approved March 22, 1898, which directs that "the Secretary of Agriculture may use so much of this sum as he deems necessary for promoting the extension and development of foreign markets for dairy and other farm products of the United States, * * * and he is authorized to apply the moneys received from the sales of such products toward the continuation and repetition of such experimental exports."

SETTLEMENT OF ACCOUNTS.

A rendition of all accounts paid during the year was promptly made at the close of each quarter. These accounts were duly certified by the Treasury accounting officers as being correct, except those of the fourth quarter, which are now in course of settlement by the Auditor. Notwithstanding the strict legal construction and exacting regulations of the accounting officers of the Treasury, there is at this time no disallowance or suspension in the accounts of this Department, nor was there any deficiency created during the year in any of its appropriations.

ACCOUNTS OF THE FISCAL YEAR 1897 FINALLY CLOSED.

The accounts of the fiscal year ending June 30, 1897, were finally closed and the balances of the appropriations carried to the surplus fund June 30, 1899. The following statement of the appropriations, disbursements, and unexpended balances for that year is appended, and is a continuation of the detailed statement submitted in the report of this Division for 1895:

Appropriations, disbursements, and amount unexpended for the year 1897.

Object.	Appropriations, 1897.	Amount disbursed.	Amount unexpended.
Salaries, officers and clerks	\$313,860.00	\$290,791.95	\$23,068.05
Furniture, cases and repairs	12,000.00	9,567.59	2,432.41
Library	7,000.00	6,831.15	168.85
Museum	3,000.00	2,895.45	104.55
Postage	3,000.00	1,730.00	1,270.00
Contingent expenses	25,000.00	22,980.29	2,019.71
Animal quarantine stations	12,000.00	6,564.19	5,435.81
Collecting agricultural statistics	110,000.00	83,067.62	26,932.38
Botanical investigations and experiments	15,000.00	14,999.64	.36
Entomological investigations	20,000.00	18,637.01	1,362.99
Vegetable pathological investigations	20,000.00	19,274.15	725.85
Biological investigations	17,500.00	17,483.05	16.95
Pomological investigations	6,000.00	4,981.52	1,018.48
Laboratory	12,400.00	10,800.18	1,599.82
Forestry investigations	20,000.00	19,514.88	485.12
Experimental gardens and grounds	20,000.00	19,483.28	516.72
Soil investigations	10,000.00	9,868.16	131.84

Appropriations, disbursements, and amount unexpended for the year 1897—Cont'd.

Object.	Appropriations, 1897.	Amount dis- bursed.	Amount unex- pended.
Grass and forage plant investigations	\$10,000.00	\$9,203.14	\$796.86
Fiber investigations	5,000.00	4,143.00	857.00
Agricultural experiment stations [\$750,000] <i>a</i>	30,000.00	29,171.57	828.43
Nutrition investigations	15,000.00	14,821.64	178.36
Public road inquiries	8,000.00	7,873.97	126.03
Publications	70,000.00	67,709.89	2,290.11
Purchase and distribution of valuable seeds	150,000.00	142,822.52	7,177.48
Salaries and expenses, Bureau of Animal Industry	650,000.00	642,715.68	7,284.32
Total	1,564,760.00	1,477,931.52	86,828.48
WEATHER BUREAU.			
Salaries	150,540.00	145,043.60	5,496.40
Fuel, lights, and repairs	8,000.00	7,414.48	585.52
Contingent expenses	8,000.00	7,776.51	223.49
General expenses	717,232.00	710,546.87	6,685.13
Total, Weather Bureau	883,772.00	870,581.46	13,190.54
Grand total	2,448,532.00	2,348,512.98	100,019.02

a Of this amount, \$720,000 is paid directly to the experiment stations from the Treasury Department.

MONTHLY CHECK STATEMENTS.

The monthly check statements, rendered by the Treasury at Washington, D. C., and subtreasuries at Chicago and New York, were properly compared and certified as agreeing with the records of this office. During the year seven checks were lost, of which three were lost in the mails and four by the payees. There are now twelve checks outstanding over three years. These checks, under the law, will be covered into the Treasury by warrant, and be carried to the credit of the parties in whose favor they were respectively issued, to an appropriation account denominated "Outstanding liabilities." For the information of persons interested, it is stated that a duplicate check may be issued at the expiration of six months, by the party in interest complying with certain regulations, which will be fully explained on application to this office.

STATEMENT TO CONGRESS OF ANNUAL EXPENDITURES.

A detailed report of the expenditures of all appropriations for the fiscal year ending June 30, 1898, including the names of persons employed and the sums paid to each, was prepared in this office and transmitted through the Speaker of the House prior to the last session of Congress. This report was subsequently printed by order of Congress, and may be obtained on application to the House Document Room.

CONTRACT FOR SEEDS.

Bids were invited early in September, 1898, for furnishing valuable seeds to the Department for the fiscal year 1899 for Congressional distribution. Seedsmen were invited to submit their proposals on the list of seeds furnished by the Department, and on the same terms and conditions as heretofore. Nine bids were received in response to this circular against twenty-four for the preceding year, varying in amount from \$70,978.36 to \$120,000. After a comparison and tabulation of

the bids by a duly appointed board, an award was made to the New York Market Gardeners' Association, the lowest bidder. A contract dated October 19, 1898, containing substantially the same terms and conditions of the contract for previous year, supported by an ample bond, was prepared in this office, duly executed, and recorded.

ANNUAL SUPPLIES.

The usual advertisement soliciting bids for annual supplies to be furnished to this Department during the year was issued April 1, 1898, and all bids were opened on May 5, following. These bids were carefully passed upon by a board of award, recommendations made to and approved by the Secretary of Agriculture, and all papers forwarded to the Treasury for final action, as required by law. These recommendations were subsequently approved, when contracts were awarded at satisfactory rates and all contracts secured by bonds acceptable to the Department.

ESTIMATES OF APPROPRIATIONS.

The estimates of appropriations for the year ending June 30, 1900, were prepared in this Division, based on recommendations submitted by chiefs of Bureaus, Divisions, and Offices of the Department. These estimates, aggregating \$3,127,722, were approved by the Secretary of Agriculture and transmitted to the Secretary of the Treasury, as required by law. All differences in the estimates from the appropriations of preceding years were carefully and fully explained in footnotes for the information and guidance of the proper committees of Congress. In addition to these footnotes all variations in the estimates were orally explained to the Committee on Agriculture, who visited the Department for the purpose of personal inspection of its accounts and inquiry as to its needs.

During the three years ending June 30, 1900, the appropriations of the Department show a total increase of \$557,490, correspondingly increasing the work of the Division of Accounts and Disbursements, and making additional clerical assistance necessary for the ensuing year.

The appropriation for the Weather Bureau for 1900 includes the sum of \$25,000 for the erection of a brick addition to the annex of the present building. The contract has been awarded to the lowest bidder, Mr. D. F. Mockabee, at \$22,561, and the building is now in course of construction.

Sixty thousand dollars is appropriated for 1900 for meteorological stations in the West Indies, against \$75,000 for the same purpose for 1899. The first appropriation made for this work was included in the sundry civil bill for 1899, the money to be expended under the direction of the President. Twelve stations have been established in the West Indies under this act.

The appropriation act for 1900 provides the sum of \$1,000 to enable the Secretary of Agriculture to investigate and report on the cost of making tea in the Southern States, etc. This item in the appropriation was not estimated for by the Department, but was inserted in the bill by Congress.

Three additional clerkships of the first class were added to the statutory roll of the Secretary, instead of one first-class and two second-class, as estimated for by the Department.

The statutory salaries of the chiefs of the pathological and biochemic divisions of the Bureau of Animal Industry were increased by the appropriation act for 1900 from \$2,250 to \$2,500 each; while the salary of the chief of the miscellaneous division was raised from \$2,000 to \$2,250, and that of the Zoologist from \$2,000 to \$2,250.

MODIFICATION OF SECTION 3709, REVISED STATUTES.

A construction, according to the letter of the law, of section 3709 of the Revised Statutes, by the present Comptroller of the Treasury, made it most difficult for this Department to do business through the usual commercial channels. A strict compliance with the ruling imposed hardships and annoyances, in addition to entailing upon the Government clerical and other expense out of all proportion to the very limited benefit accruing thereto. In order to relieve the situation, which had become quite serious, Congress was appealed to for relief, and the troublesome section was modified in the appropriation act for the fiscal year 1900, as follows: "That hereafter section thirty-seven hundred and nine of the Revised Statutes of the United States shall not be construed to apply to any purchase or service rendered in the Department of Agriculture when the aggregate amount involved does not exceed the sum of fifty dollars." This modification relieves the Department officials of great embarrassment.

TELEPHONE SYSTEM.

The telephone system of thirteen stations, established about a year ago, was augmented during the year just closed by twelve additional inside stations, thus directly connecting all the Bureaus, Divisions, and Offices of the Department, and establishing a complete and satisfactory service with the several branches of the Department, and all connections of the central telephone exchange. By the law of June 30, 1898, the price for telephone service in the District of Columbia is fixed, and at rates much lower than those provided by the Department contract with the telephone company of May, 1898, for the first two years. This law is now being contested by the telephone company.

CLAIM OF W. D. HUNTER.

The deficiency estimates submitted by the Secretary of the Treasury for the fiscal year ending June 30, 1900, contained an item to "reimburse W. D. Hunter the amount paid by him for loss of a hired horse, damages to vehicle and harness, and expense of removal of same while in the discharge of his official duties as special agent of the Department of Agriculture, \$125."

This was not a deficiency in the appropriation (entomological) but merely a claim for reimbursement, which had to be submitted to Congress for adjustment. All the papers and evidence in the case clearly show the claim to be a just one, which, doubtless, would have received the approval of Congress had the papers been submitted with the claim. These papers were, however, inadvertently retained in the Treasury Department. In view of the entire justice and reasonableness of the claim, it is strongly recommended that it be stated to Congress at its next session, in the deficiency estimates presented annually by the Treasury, when, it is confidently believed, the claim will be allowed.

PAYMENT OF SALARIES FROM LUMP-SUM APPROPRIATIONS IN THE DISTRICT OF COLUMBIA.

In a letter from the Comptroller of the Treasury, dated March 24, 1899, to the chief of this Division, exception is taken to the payment of salaries to employees of the Department in the District of Columbia from "lump-sum" or "general" appropriations, as being in contravention of the statutes (22 Stat. L., p. 235). The exception has not yet taken the form of a legal "opinion."

For many years a large proportion of nearly all the lump appropriations has been expended in the payment of salaries, and the accounts containing these disbursements for salaries have hitherto all passed the administrative scrutiny of every accounting officer to whom they have been presented. If the Comptroller should render an official opinion unfavorable to this practice, it would be clearly a reversal of established usage and of prior decisions. Such a decision would work an intolerable hardship to the Disbursing Officer who, in good faith, and relying on the judgment of all accounting officers, made, and is still making, the payments, and is thus responsible for immense sums. The effect of a decision based upon the reasoning upon which the said exceptions are founded would be disastrous, both to the Disbursing Officer and to the Department work, one-half of the employees of the Department being paid from lump appropriations. Aside from the harshness of such action upon the employees themselves, the operations of the Department would be most seriously crippled. The committees of both Houses of Congress charged with the consideration of appropriations for this Department have been fully cognizant of the fact that for years it has been the practice of the Department to pay employees from practically all of the general appropriations. Evidence of Congressional familiarity with and approval of this practice will be found in the circumstance that in making the appropriations for "Collecting agricultural statistics" for the fiscal year ending June 30, 1900, a clause was added limiting the amount that might be expended "for salaries in the city of Washington, District of Columbia." In order to carry into effect any of the purposes set forth in the lump-sum appropriations, it is absolutely necessary to expend a large percentage of the amount so appropriated in payment of salaries. These purposes would be utterly thwarted if it should be decided that no part of the appropriation could be used in the payment of salaries to employees at Washington. The language of the lump-sum appropriations clearly indicates that Congress intended that salaries should be paid therefrom, the words "labor," "investigation," "experiments," etc., appearing in nearly all of them.

However all doubt on this point should be removed by Congress either modifying the law or by making the necessary change in the verbiage of the questionable general appropriations, and it is earnestly recommended this change be provided for in the estimates of appropriations for 1901.

BUILDINGS RENTED BY THE DEPARTMENT.

CHEMICAL LABORATORY.

In July, 1890, the Department leased a building on the southeast corner of B and Fourteenth streets SW. for the use of the chemical laboratory, at an annual rental of \$900, on which extensive repairs

were made by the Department before occupying it. The building was used for laboratory and office purposes until the summer of 1898, when, on account of being unsafe and entirely unfit for these purposes, it was torn down and a new, commodious, and appropriate building was erected on the same site by the owners, after consultation with the Chief Chemist of the Department. At the recommendation of that officer, who had fully discussed the matter with the owners of the property, an increase of \$300 a year in the amount of rental was provided for in the Department estimates for the fiscal year beginning July 1, 1899, and this additional amount was appropriated by Congress.

On April 1, 1899, the Department was notified in writing by the owners of the property that "the building, for further occupancy by your Division of Chemistry, is \$3,600 per annum from the 1st day of December, 1898." As the owners had already been paid the rent under the terms of the lease up to and including the month of January, 1899, which they had accepted without protest or complaint, so far as this office is aware, and as the existing lease did not expire until June 30, 1899, no attention was paid to this notice by the acting law clerk of the Department.

The building immediately adjoining to the east, occupied by the Bureau of Animal Industry as a laboratory, is owned by the same persons who own the chemical laboratory property, and for which they also demand an increase in the amount of rental from \$1,200 to \$1,800. Should this demand be acceded to, and it become necessary to pay the increased rental demanded for the chemical laboratory, this Department would be under an annual expense for rented buildings in the District of Columbia of \$7,440.

AMOUNT PAID IN EIGHT YEARS FOR LABORATORY BUILDINGS.

In this connection it is thought proper to call attention to the fact that over \$24,000 has been paid out by this Department during a period of eight years, ending June 30, 1899, in rental for the several laboratory buildings in the District of Columbia. In addition to this sum thousands of dollars have been expended on the improvement and alteration of these buildings. It would, therefore, seem proper to suggest in this report the expediency of urging upon Congress the importance, for economic and other reasons, of appropriating a sufficient sum for the erection of a suitable building for the accommodation of these several laboratories. Such an appropriation would manifestly be a good investment for the Government. No outlay for ground would be necessary, the Department reservation of thirty-odd acres affording ample room for all building purposes for the future, including a new Department building. This latter may no longer be regarded in the light of a mere convenience, but has become an absolute and urgent necessity, the importance of which should appeal to the pride and generosity of Congress with a peculiar interest. The members of the Committee on Agriculture, who are fully acquainted with the present wholly inadequate and most antiquated accommodations of the Department, have repeatedly expressed their hearty approval of a proposition for a modern building which would accommodate the several branches of the Department service, now widely separated, and occupying eleven different buildings, for five of which the Department pays an annual rental.

In the appropriation for "Botanical investigations" for the year 1899 it is provided that "a sum not exceeding one thousand dollars

may be used for the erection of a plant house for conducting botanical experiments." The same language occurs in the appropriation for 1900, except that the amount there named is \$1,500, making a total of \$2,500. To carry into effect this provision a contract has been made and a frame building with a brick foundation is now being erected on the grounds of the Department.

LEASED BUILDINGS, WITH LOCATION, AND MONTHLY OR ANNUAL RENTAL.

In the District of Columbia.—The following is a statement of the location, annual rental, and use of the several buildings under lease by this Department in the District of Columbia during the year ending June 30, 1899:

No. 1362 B street SW., Bureau of Animal Industry laboratory	\$1,200
No. 1358 B street SW., Division of Botany laboratory	720
No. 1364 B street SW., Division of Chemistry laboratory and offices	900
No. 212 Thirteenth street SW., Division of Vegetable Physiology and Pathology laboratory and offices	660
No. 214 Thirteenth street SW., Division of Soils laboratory and offices ...	660
Total	4,140

Outside the District of Columbia.—The Division of Botany has an experiment station at Kensington, Md., for which the Department pays a rental of \$50 per annum.

The following are the Bureau of Animal Industry and Weather Bureau stations under lease by the Department of Agriculture outside of the District of Columbia during the year ending June 30, 1899:

BUREAU OF ANIMAL INDUSTRY.

Stations, with location and monthly or annual rental.

Station.	Location.	Rent.
Baltimore, Md	No. 215 St. Paul street	\$125 per annum.
Bethesda, Md	Montgomery County	\$50 per month.
Boston, Mass	No. 21 Doane street	\$40 per month.
Buffalo, N. Y	East Buffalo Live Stock Exchange Building	\$30 per month.
Chicago, Ill	No. 4193 South Halsted street	\$300 per month.
Do	Exchange Building, Union Stock Yards	\$15 per month.
Garfield, N. J	(Quarantine station)	\$1,800 per annum.
Indianapolis, Ind	Kingan & Co.'s abattoir	\$10 per month.
Kansas City, Kans	No. 74 South James street	\$45 per month.
Do	Live Stock Exchange Building	\$15 per month.
Littleton, Mass	(Quarantine station)	\$250 per annum.
National Stock Yards, Ill	Live Stock Exchange Building	\$75 per month.
New York, N. Y	No. 18 Broadway	\$500 per annum.
Do	No. 109 West Forty second street	\$40 per month.
Norfolk, Va	No. 70 Plum street	\$12 per month.
San Francisco, Cal	87 Flood Building	\$20 per month.
South Omaha, Nebr	Over Packers' National Bank	\$55 per month.
South St. Joseph, Mo	St. Joseph Packing and Transportation Company Building	\$15 per month.
St. Denis, Md	(Quarantine station)	\$225 per annum.

WEATHER BUREAU.

Stations, with location and annual rental, including such items as heat, light, janitor, ice, brooms, matches, etc.

No.	Station.	Location.	Amount.	Rent. Includes—
UNITED STATES STATIONS				
1	Ablene, Tex.	On South 1st street	a \$24.45	Heat, cleaner, oil, matches, ink, mucilage, brooms, ice, and water.
2	Albany, N. Y.	In public building, corner Broadway and State streets	a 211.36	Heat, cleaner, light, oil, matches, ink, and mucilage.
3	Alpena, Mich.	Corner Fletcher and Dock streets	a 200.00	Heat, cleaner, oil, matches, and ice.
4	Amarillo, Tex.	Corner Folk and 5th streets	a 180.00	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, and ice.
5	Astoria, Oreg.	In Western Union Building, No. 491 Commercial street	a 900.00	Heat, janitor service, light, and ice water.
6	Atlanta, Ga.	In Prudential Building, corner Broad, Walton, and Forsyth streets	a 137.00	Heat and light.
7	Atlantic City, N. J.	In Real Estate and Law Building, 1421 Atlantic avenue	a 310.00	Heat, cleaner, light, matches, ink, mucilage, brooms, ice, and soap.
8	Augusta, Ga.	In public building, corner Campbell and Greene streets		
9	Baker City, Oreg.	In Bloch Building, on Main street		
10	Baltimore, Md.	Johns Hopkins University, 532 North Howard street		
11	Birmingham, N. Y.	In public building, corner Wall and Henry streets	b 120.00	Electric light and telephone.
12	Birmingham, Ala.	In Walker & Jordan Building, 2011 1st avenue		
13	Bismarck, N. Dak.	In public building, corner Main and 1st streets	a 259.97	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, ice, and use of cellar.
14	Block Island, R. I.	{ On Main street	b 20.00	For exposure of wind instruments.
15	Boise, Idaho	On cupola of National Hotel, on Main street	a 480.00	Heat, janitor service, light, hot and cold water.
16	Boston, Mass.	In public building, Post-Office square		
17	Buffalo, N. Y.	In Prudential Building, corner Pearl and Church streets	a 504.76	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, and ice.
18	Cairo, Ill.	In public building, corner Washington avenue and 14th street.		
19	Canby, Fort, Wash.	Weather Bureau Building, summit of Cape Hancock.		
20	Cape Henry, Va.	In Weather Bureau Building, on the beach.	a 300.00	Heat, cleaner, and light.
21	Cape May, N. J.	In Ocean House, corner Decatur street and Beach avenue		
22	Carson City, Nev.	In public building, on Carson street	a 284.00	Heat, janitor, light, oil, matches, brooms, ice, and water.
23	Cedar City, Utah	In Jones Building, No. 318 Main street		
24	Charleston, S. C.	In public building, 200 East Bay street		
25	Charlotte, N. C.	In public building, corner Trade and Mint streets		
26	Chattanooga, Tenn.	In public building, corner 11th and A streets		
27	Cheyenne, Wyo.	In Commercial Building, 216-218 West 16th street	a 367.61	Heat, cleaner, light, matches, ink, mucilage, brooms, ice, water, and soap.
28	Chicago, Ill.	Auditorium Building, corner Wabash avenue and Congress street.	a 1,800.00	Heat, cleaner, light, oil, matches, ink, mucilage, ice, water, soap, and elevator.

a In accordance with existing lease.

b Under informal written agreement, lease being impracticable.

WEATHER BUREAU—continued.

Stations, with location and annual rental, including such items as heat, light, janitor, ice, brooms, matches, etc.—Continued.

No.	Station.	Location.	Amount.	Rent.	Includes—
UNITED STATES STATIONS—continued.					
29	Cincinnati, Ohio.....	In public building, 5th street, between Walnut and Main streets.	.....	
30	Cleveland, Ohio.....	In Society for Savings Building, corner Public Square and Ontario streets.	a \$1,140.00		Heat, cleaner, light, oil, matches, ink, muclage, brooms, ice, water, toilet supplies, power for electric motor, gas for stereotyping, electricity for signals, and storeroom.
31	Columbia, Mo.....	In Agricultural College Building, Campus State University.	.....	
32	Columbia, S. C.....	In public building, corner Main and Laurel streets.	a 616.00		Heat, cleaner, light, oil, matches, ink, muclage, brooms, ice, water, washing towels and flags, rent of telephone, gas for stereotyping, electric power for press, and district messenger service (paid to and from post-office).
33	Columbus, Ohio.....	In Eberly Block, 203-215 South High street.	.....		Heat, cleaner, light, matches, and ice.
34	Concordia, Kans.....	Post-office Building, 204 6th street.	a 220.00		Heat, cleaner, light (oil), matches, ink, muclage, brooms, soap, and ice.
35	Corpus Christi, Tex.....	In French Building, corner Chapparral and Star streets.	a 296.80		
36	Currituck Inlet, N. C.....	In United States Life Saving Station Building.	.....	
37	Davenport, Iowa.....	In public building, corner 4th and Perry streets.	.....		Heat, cleaner, electric light and power, oil, matches, ink, muclage, brooms, ice, water, soap, and elevator.
38	Denver, Colo.....	In public building, corner 16th and Arapahoe streets.	.....		Heat, cleaner, light, matches, ink, muclage, brooms, ice, water, soap, brushes, stove polish, and lavatory.
39	Des Moines, Iowa.....	In public building, corner 5th street and Court avenue.	a 550.00		
40	Detroit, Mich.....	Union Trust Building, corner Griswold and Congress streets.	a 355.65		Heat and light.
41	Dodge, Kans.....	Beeson Block, on Front street.	a 400.00		Heat, cleaner, washing towels, light, oil, matches, ice, and water.
42	Dubuque, Iowa.....	Bank and Insurance Building, corner Main and 9th streets.	b 400.00		
43	Duluth, Minn.....	In public building, 1st street and 5th avenue, west.	.....	
44	Eagle, Alaska.....	In telegraph office, Frontier street.	.....	
45	East Chatham, Wash.....	In public building, corner Water and Washington streets.	a 300.00		Heat, cleaner, light, oil, matches, ink, muclage, brooms, ice, water, and soap.
46	Eastport, Me.....	In Warfield & Dann Building, corner 3d street and Davis avenue.	.....	
47	Elkins, W. Va.....	In public building, St. Louis and Oregon streets.	.....	
48	El Paso, Tex.....	In public building, Park Row and State street.	.....	
49	Erie, Pa.....	In Semer Block, corner Ludington street and Harrison avenue.	a 436.00		Heat, cleaner, light, oil, matches, ink, muclage, brooms, ice, water, and soap.
50	Escanaba, Mich.....	In Buhrne's brick building, corner 2d and G streets.	a 375.00		Heat, cleaner, light, oil, matches, ink, muclage, brooms, ice, water, and soap.
51	Eureka, Cal.....	In Federal Building, 2d street, between Vine and Sycamore streets.	.....	
52	Evansville, Ind.....	In Federal Building, 2d street, between Vine and Sycamore streets.	.....	

53	Flagstaff, Ariz.	In Milligan Cottage, corner Aspen avenue and Park street.			Heat, cleaner, light, and ice.
54	Fort Smith, Ark	In opera house, 422-424 Garrison avenue	a 400.00	a 240.00	Heat, cleaner, light, lard oil, matches, ink, mucilage, brooms, ice, water, soap, mops, brushes, dusters, and cleaning river gauge.
55	Fort Worth, Tex	In public building, corner Jennings avenue and Texas street		a 400.00	Heat, cleaner, light, matches, ink, mucilage, brooms, ice, mops, and telephone service.
56	Fresno, Cal	Farmers' National Bank of Fresno Building, No. 1056 I street.			Heat, cleaner, light, water, elevator, brooms, ice, and soap.
57	Galveston, Tex	Levy Building, corner 23d and Market streets	a 600.00	a 237.29	Heat, cleaner, light, oil, matches, ink, mucilage, and brooms.
58	Grand Haven, Mich	Cutler House, corner 3d and Washington streets	a 480.00		Heat, janitor service, light, oil, matches, water, soap, and towels.
59	Grand Junction, Colo	In Canon Block, corner 4th and Main streets	a 300.00		Heat, cleaner, light for office and storm signals, matches, ink, mucilage, brooms, and soap.
60	Green Bay, Wis	Parmentier Block, 324-328 Washington street			Heat, cleaner, light, oil, matches, ink, mucilage, brooms, and soap.
61	Hannibal, Mo	In public building, corner Broadway and 6th street	a 154.50		Heat, cleaner, light, matches, brooms, ice, and water.
62	Harrisburg, Pa	In public building, corner 3d and Walnut streets	a 360.00		Heat, cleaner, light, matches, ink, mucilage, brooms, ice, and soap.
63	Hatteras, N. C	In Styron's house, Main road	a 420.00		Heat, cleaner, light, matches, ink, mucilage, brooms, ice, and soap.
64	Havre, Mont	In Gussenhoven Building, 1st street, between 3d and 4th avenues.	a 400.00		Heat, cleaner, light, matches, ink, mucilage, brooms, ice, and soap.
65	Helena, Mont	In Power Block, corner Main street and 6th avenue	a 270.00		Heat, cleaner, light, matches, and water.
66	Huron, S. Dak	In Jeffris Block, 337 Dakota avenue	a 1,000.00		Heat, cleaner, light, oil, matches, ink, mucilage, brooms, ice, and soap.
67	Independence, Cal	In Norman House, corner Market and Edward streets	a 600.00		Heat, cleaner, light, matches, ink, mucilage, brooms, ice, and soap.
68	Indianapolis, Ind	In Majestic Building, corner Pennsylvania and Maryland streets.			Heat, cleaner, light, matches, ink, mucilage, brooms, ice, and soap.
69	Ithaca, N. Y	In Lincoln Hall, Cornell University			Heat, cleaner, light, matches, ink, mucilage, brooms, ice, and soap.
70	Jacksonville, Fla	In Astor Building, 138 West Bay street	a 270.00		Heat, cleaner, light, matches, ink, mucilage, brooms, ice, and soap.
71	Jupiter, Fla	In Weather Bureau Building, near light-house	a 600.00		Heat, cleaner, light, matches, ink, mucilage, brooms, ice, and soap.
72	Kalispell, Mont	In Conrad National Bank Building, corner Main and 2d streets.	a 270.00		Heat, cleaner, light, matches, brooms, ice, and water.
73	Kansas City, Mo	In Riato Building, corner Grand avenue and 9th street	a 660.00		Heat, cleaner, light, matches, ink, mucilage, brooms, ice, and soap.
74	Koosuk, Iowa	In public building, corner 7th and Blendean streets	a 470.30		Heat, cleaner, light, matches, ink, mucilage, brooms, ice, and soap.
75	Kew West, Fla	In Waite Building, corner Duval and Wall streets			Heat, cleaner, light, matches, ink, mucilage, brooms, ice, and soap.
76	Kittyhawk, N. C	In Weather Bureau Building, on the beach			Heat, cleaner, light, matches, ink, mucilage, brooms, ice, and soap.
77	Knoxville, Tenn	University of Tennessee			Heat, cleaner, light, matches, brooms, and ice.
78	La Crosse, Wis	In public building, corner 4th and State streets	a 380.00		Heat, cleaner, light, matches, brooms, and ice.
79	Lansing, Mich	In Bruce & Iam's Block, No. 36 Main street			Heat, cleaner, light, matches, brooms, and ice.
80	Lexington, Ky	In Federal Building, corner Michigan and Capitol avenues.			Heat, cleaner, light, matches, ink, mucilage, brooms, ice, and soap.
81	Lincoln, Neb	In State College Building, South Limestone street			Heat, cleaner, light, matches, ink, mucilage, brooms, ice, and soap.
82	Lincoln, Neb	In University of Nebraska Building, corner 12th and T streets.			Heat, cleaner, light, matches, ink, mucilage, brooms, ice, and soap.
83	Little Rock, Ark	In public building on 2d street between Center and Spring.	a 563.30		Heat, cleaner, light, matches, ink, mucilage, brooms, ice, and water.
84	Los Angeles, Cal	In Wilson Building, 102½ South Spring street	a 270.00		Heat, cleaner, light, matches, ink, mucilage, brooms, ice, and water.
85	Louisville, Ky	In public building, corner 4th and Chestnut streets			Heat, cleaner, light, matches, ink, mucilage, brooms, ice, and water.
86	Lynchburg, Va	In Law Building, 807 Main street			Heat, cleaner, light, matches, ink, mucilage, brooms, ice, and water.

a In accordance with existing lease.

b Under informal written agreement, lease being impracticable.

WEATHER BUREAU—continued.

Stations, with location and annual rental, including such items as heat, light, janitor, ice, brooms, matches, etc.—Continued.

No.	Station.	Location.	Amount.	Rent. Includes—
UNITED STATES STA- TIONS—continued.				
87	Macon, Ga.	In public building, corner 3d and Mulberry streets.		
88	Marquette, Mich.	In public building, corner 3d and Washington streets.		
89	Memphis, Tenn.	In Continental National Bank, corner Main and South Court streets.	<i>a</i> \$600.00	Heat, cleaner, light, water, and elevator.
90	Meridian, Miss.	In public building, corner 22d avenue and 8th street.		
91	Miles City, Mont.	In Leighton Building, on Main street.	<i>a</i> 168.00	Heat, light, oil, matches, ink, muclage, brooms, and ice.
92	Milwaukee, Wis.	In public building, Wisconsin street between Jefferson and Jackson streets.		
93	Minneapolis, Minn.	In public building, corner 3d street and 1st avenue, south.		
94	Mobile, Ala.	In public building, corner St. Francis and Royal streets.		
95	Montgomery, Ala.	In public building, corner Lawrence street and Dexter avenue.		
96	Moorhead, Minn.	In First National Bank, corner Front and 6th streets.	<i>a</i> 265.25	Heat, cleaner, light for office, matches, ink, muclage, brooms, ice, water, soap.
97	Mount Tamalpais, Cal.	In Observatory Building, eastern peak Mount Tamalpais.	<i>a</i> 420.00	Heat, light, oil, matches, ink, muclage, brooms, water, and transportation for employees and supplies.
98	Mount Washington, N. H.	On summit.	<i>a</i> 5.00	For rent of ground on which Weather Bureau building is located.
99	Nantucket, Mass.	In Pacific Clubhouse, corner Main and Water streets.	<i>a</i> 270.00	Heat, light, ink, muclage, brooms, ice, water, and electric light for signals.
100	Narragansett Pier, R. I.	In Odden Cottage, Kingsdown street.	<i>a</i> 150.96	Heat, light, matches, ink, muclage, and brooms.
101	Nashville, Tenn.	In Chamber of Commerce, No. 307 Church street.	<i>b</i> 400.00	Heat, cleaner, light, matches, ink, muclage, brooms, ice, and soap.
102	Neah, Wash.	In Indian Agency Building, facing bay.		
103	New Brunswick, N. J.	In New Jersey Experiment Station Building, corner Bleeker Place and Hamilton street.		
104	New Haven, Conn.	In Insurance Building, No. 890 Chapel street.	<i>a</i> 400.00	Heat, cleaner, light, matches, ink, muclage, brooms, ice, water, and soap.
105	New Orleans, La.	In public building, corner Devatur and Custom-house streets.		
106	New York, N. Y.	In American Surety Building, 100 Broadway.	<i>a</i> 2,500.00	Heat, cleaner, light for office and signals, electricity or gas for stereotyping, electric current for printing press, use of flagstaff, elevators, roof, and storage for property.
107	Norfolk, Va.	In Citizens' Bank Building, 191-195 Main street.	<i>a</i> 525.00	Heat, cleaner, light, ice, and water.
108	Northfield, Vt.	In Norwich University, on Central street.		
109	North Platte, Nebr.	In Odd Fellows' Hall, corner 5th and Dewey streets.	<i>a</i> 338.50	Heat, cleaner, light, matches, ink, muclage, brooms, ice, and soap.
110	Oklahoma, Okla.	In Opera House Block, corner Robinson street and Grand avenue.	<i>a</i> 510.00	Heat, cleaner, light, ink, muclage, brooms, ice, and water.

111	Omaha, Nebr.....	In public building, corner 16th and Dodge streets.....	.....	Heat, cleaner, light, oil, matches, ink, muclage, brooms, ice, water, and soap.
112	Oswego, N. Y.....	In public building, Oneida street.....	a 314. 00	
113	Palestine, Tex.....	In Colley-Wright Building, 1-5 Sycamore street.....	.....
114	Parkersburg, W. Va.....	In public building, corner 5th and Juliana streets.....	.....
115	Pensacola, Fla.....	In public building, corner Palafox and Government streets.....	a 300. 00	
116	Phoenix, Ariz.....	In Wharton Building, No. 38 North Center street.....	.....
117	Philadelphia, Pa.....	In public building, corner 9th and Chestnut streets.....	a 144. 00	
118	Pierre, S. Dak.....	Corner Attica and Tiffin streets.....	.....	Heat, light, matches, ink, muclage, brooms, ice, water, and soap.
119	Pittsburg, Pa.....	In public building, Smithfield street, 3d to 4th avenues.....	.....
120	Pocatello, Idaho.....	In light-house building.....	.....
121	Point Reyes Light, Cal.....	In Hart Building, corner 3d and A streets.....	a 96. 00	
122	Port Crescent, Wash.....	In Federal Building, corner 6th and Water streets.....	.....	Heat, cleaner, light, oil, matches, ink, muclage, brooms, ice, and soap.
123	Port Huron, Mich.....	First National Bank, 57 Exchange street.....	a 504. 00	
124	Portland, Me.....	In Oregonian Building, corner 6th and Alder streets.....	b 840. 00	
125	Portland, Oreg.....	In public building, corner 6th and Main streets.....	.....	Heat, cleaner, light, oil, matches, ink, muclage, brooms, ice, water, soap, brushes, dusters, and towels.
126	Pueblo, Colo.....	In Fisher Building, corner Fayetteville street and Exchange Place.....	a 580. 00	
127	Raleigh, N. C.....	In Lakota Building, corner 7th and St. Joe streets.....	a 276. 00	
128	Rapid City, S. Dak.....	In Cone & Kimball Building, corner Main and Walnut streets.....	a 386. 25	
129	Red Bluff, Cal.....	In Chamber of Commerce Building, corner 9th and Main streets.....	a 580. 00	
130	Richmond, Va.....	In Marks Building, 228½ Jackson street.....	a 399. 00	
131	Rochester, N. Y.....	In public building, corner Church and Fitzhugh streets.....	.....	Heat, cleaner, light, oil, matches, ink, muclage, brooms, ice, soap, and chimneys.
132	Roseburg, Oreg.....	In Chamber of Commerce Building, 112 East 6th street.....	a 300. 55	
133	Sacramento, Cal.....	In public building, corner 7th and K streets.....	a 600. 00	
134	St. Louis, Mo.....	In public building, on Olive street between 8th and 9th streets.....	a 192. 00	
135	St. Paul, Minn.....	In Chamber of Commerce Building, 112 East 6th street.....	.....	Heat, cleaner, light, matches, brooms, water, and elevator.
136	Salt Lake City, Utah.....	In Dooley Block, corner West Temple and Second South streets.....	a 300. 00	
137	San Antonio, Tex.....	In Maverick Bank Building, corner Houston street, Alamo Plaza.....	a 380. 00	
138	San Diego, Cal.....	In Keating Building, corner 5th and F streets.....	.....	Heat, cleaner, light, matches, ink, muclage, brooms, and ice.
139	Sandusky, Ohio.....	In public building, corner Columbus avenue and Market street.....	a 1,290. 00	
140	San Francisco, Cal.....	In Mills Building, corner Bush and Montgomery streets.....	a 300. 00	
141	San Luis Obispo, Cal.....	In Rackerliffe Building, corner Choro and Marsh streets.....	a 420. 00	
142	Santa Fe, N. Mex.....	In Catron Building, corner Plaza on Palace avenue.....	.....	Heat, cleaner light water, electric power for printing press, and gas for stereotyping.
143	Sault Ste. Marie, Mich.....	In Weather Bureau building, on Government reservation known as "Canal grounds,".....	a 300. 00	
144	Savannah, Ga.....	In public building.....	a 420. 00	Heat, cleaner, light, matches, ink, muclage, brooms, ice, water, and soap. Heat, light, and water.

a In accordance with existing lease.

b Under informal written agreement, lease being impracticable.

WEATHER BUREAU—continued.

Stations, with location and annual rental, including such items as heat, light, janitor, ice, brooms, matches, etc.—Continued.

No.	Station.	Location.	Amount.	Rent. Includes—
UNITED STATES STA- TIONS—continued.				
145	Seattle, Wash.	In New York Building, No. 704 2d avenue	a \$480.00	Heat, cleaner, light, and water.
146	Shreveport, La.	In public building, corner Texas and Marshall streets		
147	Sioux City, Iowa	In public building, corner 6th and Douglas streets		
148	Spokane, Wash.	In Jantson Building, 705 Riverside avenue	a 480.00	Heat, cleaner, light, and water.
149	Springfield, Ill.	In public building, corner Monroe and 6th streets		
150	Springfield, Mo.	In public building, corner Boonville and Brower streets	a 240.00	Heat, cleaner, and light.
151	Tacoma, Wash.	In Chamber of Commerce Building, corner Canal and 9th streets	a 328.75	Heat, cleaner, light, matches, ink, mucilage, and ice.
152	Toledo, Ohio	In Knight Building, No. 314 Franklin street		
153	Topeka, Kans.	In public building, corner Madison and St. Clair streets	a 350.00	Heat, cleaner, light, ink, mucilage, brooms, ice, and water.
154	Twin, Wash.	In Columbia Building, 112 West 6th avenue	b 60.00	
155	Valentine, Nebr.	In schoolhouse	a 300.00	Heat, cleaner, light, oil, matches, and brooms.
156	Vicksburg, Miss.	In Davenport Building, corner Catherine and Main streets	a 260.00	Heat, light, oil, matches, ink, mucilage, brooms, ice, wicks, shades, and chimneys.
157	Vineyard Haven, Mass.	In public building, corner Crawford and Walnut streets	a 295.80	Heat, cleaner, brooms, and soap.
158	Walla Walla, Wash.	In Eagleson Block, west side Main street	a 330.00	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, ice, and soap.
159	Wichita, Kans.	In Paine Brothers' Building, corner Main and 2d streets	a 300.00	Heat, cleaner, and light.
160	Williston, N. Dak.	In The Sedgewick, corner 1st and Market streets	a 268.00	Heat, cleaner, light, matches, ink, mucilage, brooms, and water.
161	Winchester, N. C.	Corner Main and Broadway		
162	Winnetonka, N. C.	In public building, corner Front and Chestnut streets		
163	Winnemucca, Nev.	In county court-house, on Bridge street		
164	Woods Hole, Mass.	In Fish Commission building, on Main street		
165	Yankton, S. Dak.	In Union Block, corner 3d and Walnut streets	a 280.00	Heat, cleaner, light, matches, ink, mucilage, brooms, ice, water, and soap.
166	Yuma, Ariz.	In public building, on Government reservation		
	Total		38,141.35	
WEST INDIAN STATIONS.				
1	Basseterre, St. Kitts	In American House, Liverpool Row	b 288.00	Observatory platform and storage.
2	Bridgetown, Barbados	In Ice House, corner McGregor and Broad streets	b 332.00	Cleaner, light, oil, matches, ink, mucilage, brooms, ice, water, soap, and towels.
3	Cienfuegos, Cuba	In Union Hotel	b 480.00	Janitor, light, water, washing towels, and use of roof.
4	Havana, Cuba	In Rivas Building	b 1,200.00	
		At No. 109 Lagunas street	b 240.00	
		In Hacienda, between Obispo and Obispa streets		

REPORT OF THE CHIEF OF THE SECTION OF FOREIGN MARKETS.

U. S. DEPARTMENT OF AGRICULTURE,
SECTION OF FOREIGN MARKETS,
Washington, D. C., September 1, 1899.

SIR: I have the honor to submit herewith the report of the Section of Foreign Markets for the fiscal year ended June 30, 1899.

Respectfully,

FRANK H. HITCHCOCK,
Chief.

Hon. JAMES WILSON, *Secretary.*

WORK OF THE YEAR.

The unprecedented growth of the exports of the United States within the last few years has naturally attracted much attention to the possibilities of further commercial development. Owing to the more general interest thus aroused in foreign trade matters, the demands upon the Section of Foreign Markets for information were far greater during the past fiscal year than ever before.

INQUIRIES REGARDING OUR NEW DEPENDENCIES.

As in the year preceding, many inquiries were received relative to the commercial opportunities offered by the former Spanish possessions that have recently been brought into such close relationship to the United States. Following the annexation of Porto Rico, much information was requested in reference to the trade possibilities of this new territorial acquisition, and similar requests were received with great frequency regarding Cuba and the Philippines. The scarcity of available data respecting these islands added greatly to the work of furnishing the desired information, and much time was necessarily consumed in the task.

COMMERCIAL POSSIBILITIES OF CHINA AND RUSSIA.

Aside from the inquiries regarding Porto Rico, Cuba, and the Philippines, the past fiscal year showed an exceptionally active demand for information about our foreign commerce in other directions, resulting, no doubt, from the recent successes of our exporters in developing new markets. Among the countries that were made the subject of frequent inquiry, China and Russia were the most conspicuous. The fact that these two vast countries will probably offer the greatest commercial possibilities of the immediate future seems to have become generally recognized. Unfortunately, China and Russia are both nations in regard to which there is a dearth of reliable statistical data, and the task of supplying the facts requested, as in the case of the former Spanish possessions, was extremely difficult.

PUBLICATIONS.

Owing to the large amount of labor and time required to comply with the numerous requests for information received during the fiscal year 1899, the Section had less opportunity than in former years for the preparation of publications.

REPORT ON THE TRADE OF THE PHILIPPINES.

The report on the trade of the Philippine Islands begun in the preceding fiscal year required an unusual amount of research. It was found that the meager statistics to be had from Spanish sources gave a very inadequate idea of the commerce that actually belonged to the Philippines, and in order to ascertain with accuracy the extent and value of the trade it became necessary to collate from the published records of the various countries enjoying commercial intercourse with the islands such statistics upon the subject as they presented. The compilation of these statistics from the numerous foreign trade reports and their conversion into United States equivalents formed a task that occupied the force of the Section for several months. The report when completed made a pamphlet of 160 pages, and included practically all the authentic statistical information regarding the commerce of the Philippines that has been published in the official trade returns of the various countries of the world.

REPORT ON THE PLANT PRODUCTS OF THE PHILIPPINES.

Following the report on the trade of the Philippines, the Section prepared for publication a report dealing with the agricultural resources of the islands, and especially with the various plant products, the demand for information upon this subject seeming to require some printed matter for distribution. The report contained a general description of the most important of the Philippine cereals, vegetables, fruits, fibers, dye plants, etc., supplemented, when practicable, by statistics of production, price, and exportation. As the report was largely botanical in its general features, it was published as a circular of the Division of Botany, under the title "Notes on the plant products of the Philippine Islands."

REPORT ON THE AGRICULTURAL TRADE OF THE UNITED STATES FOR 1898.

When the final customs returns showing the imports and exports of the United States for the fiscal year 1898 became available, the Section turned its attention to the preparation of a report setting forth the leading features of the year's commerce, so far as it consisted of products of agriculture.

The record for 1898 proved to be a remarkable one. The agricultural exports were decidedly the largest in the history of the country. Their total value reached the enormous figure of \$858,507,942, exceeding the highest previous record by more than \$50,000,000. As compared with the valuation recorded for the preceding fiscal year there was a gain of \$168,752,749, or nearly 25 per cent. While this extraordinary advance in value was unquestionably due partly to the higher prices that prevailed during 1898, there was nevertheless a marked increase also in the quantity of the products shipped. Among the exports that showed the largest gains were wheat and wheat flour, corn, oats, rye, bacon, lard, hams, cotton-seed oil, and oil cake.

Official statistics as to the quantity and value of each of these leading agricultural exports, as well as the numerous other products of American agriculture marketed abroad, were presented in the report, and a comparison made in each case with the records of the year preceding. The report also reviewed in a similar manner the agricultural imports of the United States during 1898, contrasting the returns of that year with those for 1897.

As regards our agricultural imports, it was found that a marked falling off had occurred. The products of agriculture received from foreign countries in 1898 had a total valuation of only \$314,291,796, which was \$86,579,672 less than the figure recorded the year before. The decline, therefore, amounted to about 22 per cent. Sugar and wool were the principal factors in this falling off.

The report was supplemented by a series of statistical tables showing in detail the quantity, value, and average price of the various agricultural imports and exports during each of the five years, 1894-1898. For convenience in distribution, some of these tables were afterwards republished as a circular.

STATISTICS FOR FUTURE PUBLICATIONS.

In addition to the several reports just mentioned, the Section prepared during the past fiscal year a number of elaborate statistical statements for use in future publications.

INVESTIGATIONS IN NORTHERN EUROPE.

Under instructions from the Secretary of Agriculture, the chief of the Section sailed on May 26 for northern Europe to investigate certain matters relative to our foreign trade in agricultural products. The first place visited in the course of the investigation was Copenhagen, Denmark. The inquiries made at this port extended through the latter half of June to the close of the fiscal year.

DANISH IMPORTS FROM THE UNITED STATES.

A study of the Danish imports from the United States revealed some interesting facts. As regards the importation of American agricultural products, it was found that Denmark, although essentially an agricultural country, was importing in considerable quantities from the United States some of the articles that enter most extensively into the Danish export trade, as, for instance, butter and bacon. The explanation lies in the fact that the thrifty Danes, instead of consuming their own produce, find it more profitable to purchase for home consumption the cheaper, but highly satisfactory, American commodities, thereby making it possible to export to a larger extent the Danish goods for which they have established such a favorable reputation abroad.

Thus, in the case of butter, which is decidedly the leading export from Denmark, a large amount of the American product, principally of the lower grades, is annually imported to replace in domestic use the high-priced Danish article that can be disposed of so profitably in Great Britain.

A similar condition prevails, although to a less extent, as regards bacon. American bacon is now being consumed quite largely in Denmark, while the domestic article, produced with special reference to

the requirements of the British market and commanding there a high price, is shipped to England in constantly increasing amounts.

Still other agricultural imports from the United States are similarly utilized to take the place of domestic products that are reserved for exportation. It is apparent that such imports do not compete to any extent with the products of domestic agriculture. On the contrary, they are of great advantage to Danish agriculturists, permitting them to send to the profitable British markets larger quantities of the produce of their farms.

AMERICAN WHEAT FLOUR IN DENMARK.

One of the few agricultural exports of the United States that are beginning to compete seriously with Danish products is wheat flour. During the fiscal year 1898 our shipments of this article to Denmark amounted to 61,019 barrels, or more than 20,000 barrels in excess of the largest shipments previously sent. Danish bakers find that American flour is practically as good as the best Hungarian, and, as it is less expensive, they are beginning very generally to substitute it for the latter. The millers of Denmark are also using American flour in large quantities, instead of Hungarian, to mix with their own product. Even this practice, however, does not enable the Danish mills to hold their own against the inroads that are being made by American flour. The milling industry of the Kingdom is apparently declining, and every indication points to a still further increase in the amount of flour imported from the United States.

AMERICAN FEED STUFFS IN DENMARK.

Maize, or Indian corn, has become the principal article of export from the United States to Denmark. The exports in 1896, although greater than any previously recorded, reached only 6,939,845 bushels. During the fiscal years 1897 and 1898 the shipments were exceptionally large, amounting to 18,109,701 bushels in the former year and to 16,874,943 bushels in the latter. This remarkable increase in the shipments is said to be due chiefly to a larger demand for maize as a feed stuff for live stock and poultry.

Similarly, greatly increased quantities of American oil cake are being exported to feed Danish cattle. In the fiscal year 1897 the exports of this product to Denmark were recorded at 55,958,939 pounds, exceeding all prior shipments, and yet these figures are small when compared with the returns for 1898, which place the quantity exported in that year as high as 155,121,048 pounds. The use of oil cake as a feed for live stock in Denmark is reported to be rapidly increasing.

Recently considerable quantities of bran have also been shipped from the United States to Denmark, and it is probable that still larger consignments will be required in the future.

By the importation of these cheap feed stuffs from the United States Danish farmers are able to supply themselves at the least possible cost with the necessary raw materials from which to produce the high-grade products they send to Great Britain at such profitable prices.

As the Danes are at present reclaiming for farming purposes a considerable portion of their waste lands, it is probable that the dairy and stock-growing industries of the Kingdom will be materially extended, and with this development the market there for American feed stuffs will undoubtedly be still further widened.

COMPLAINTS AGAINST AMERICAN MAIZE.

The investigations made at Copenhagen included a careful inquiry into certain complaints made by importers there as regards the quality and condition of some of the shipments of American maize received at that port. Such cargoes as arrived during the time spent at Copenhagen were thoroughly examined in the ship at the various stages of unloading and after discharge with a view to ascertaining by personal observation the actual quality and condition of the grain when it arrived. In instances of poor quality or damaged condition, samples were taken, accompanied by full memoranda as regards the source of the grain, export inspection, shipping firm, date of shipment, etc. Special attention was given to the circumstances attending the ocean shipment of maize, such as the manner of loading in the ship, the distribution of the cargo as regards holds and bunkers, the exposure of the grain to heat from the boilers, and the facilities for ventilation. From the inquiry made into these matters it became apparent that a considerable part of the damage complained of in the maize received from the United States was due to lack of proper care in the methods of shipment.

As the investigation of the maize question, however, was continued after the close of the fiscal year 1899, and, in fact, conducted more extensively thereafter, the results obtained will be more properly reported in connection with the work of the current fiscal year.

DANISH EXPORT METHODS.

Incidentally, in connection with the inquiries made at Copenhagen relative to the imports received from the United States, some little time was devoted to a study of Danish export methods. Considering the limited agricultural resources of their country, the Danes have developed a wonderful export trade in some of the products of the farm. The secret of their success lies chiefly in the great pains they take to cater to the particular requirements of the foreign consumer and the care they exercise to maintain the uniformly high standard of their products. Not only is every precaution taken to prevent the exportation of an inferior or damaged article, but sufficient attention is always devoted to the packing and the methods of shipment to insure the arrival in good condition of the articles exported. By years of faithful adherence to such a policy the Danes have built up for their products a reputation that gives them a great advantage in the British market, where their export trade is chiefly centered.

BUTTER EXPORTS OF DENMARK.

In studying the export methods practiced by the Danes, considerable attention was given to the shipment of butter, which is such an important item among the Danish products marketed abroad. During the calendar year 1898, according to the official statistics of Denmark, the butter exports of that country reached as high as 156,000,000 pounds, with a total value amounting to about \$33,000,000. Within a single decade the export trade in this article has been more than doubled, and at the present day the little Kingdom of Denmark is selling more butter in foreign markets than any of the other exporting countries.

The trade methods employed in the development of this remarkable export business were naturally of great interest, and a portion of the

time spent at Copenhagen was occupied in gathering information upon this subject. The facts procured will be utilized in a future publication.

COMMERCE OF THE BALTIC.

As the special investigations conducted in Denmark were to be followed by an inquiry into the possibilities of the Baltic Sea commerce generally, the opportunity was taken to make a preliminary study of this trade before leaving Copenhagen. Owing to its commanding position at the very entrance to the Baltic, Copenhagen is the natural distributing center of the maritime commerce of the regions that border upon that sea. To meet the requirements of this rapidly growing trade, there has recently been constructed in the harbor of Copenhagen an extensive and finely equipped free port for the transshipment of merchandise billed to other destinations. At this free port some interesting information was procured relative to the extent and character of the foreign commerce carried on by the Baltic countries.

From facts gathered at Copenhagen and during a subsequent visit to ports in Russia, Finland, and Sweden, it appears that the amount of American merchandise distributed through the Baltic region has increased very rapidly in the last few years. During the fiscal year 1898 our direct shipments to the three Scandinavian countries and to Baltic Russia, including Finland, amounted in value to more than \$25,000,000. Although agricultural exports still form the larger part of this item and show material gains for the past decade, the principal increase has occurred in our shipments of manufactured wares, such as machinery, tools, utensils, etc. Ten years ago the annual value of the exports of manufactured articles from the United States to the Baltic countries did not exceed \$3,000,000, while it now amounts to at least \$10,000,000. Meanwhile the annual value of our agricultural exports to the same region has risen from less than \$10,000,000 at the beginning of the decade to about \$15,000,000 at its close. The rapid growth of the maize shipments to Denmark, already mentioned, has been the leading factor in this increase, but considerable gains have also occurred in the cases of other agricultural exports, some of the most important being wheat flour, oil cake, oleo-oil, pork, hams, and tallow.

While the market for certain American agricultural products in the Baltic countries will doubtless be considerably extended, it is believed that the chief commercial opportunity in this region, as indicated by the present drift of trade, will lie in the development of a wider demand for our manufactures. As a field for trade extension along this line the Baltic countries certainly present possibilities that are well worth the attention of American exporters.

TRADE OBSTACLES.

The facts regarding the various obstacles to our export trade that were noted in the course of the investigations made at Copenhagen and other Baltic ports--such, for instance, as the lack of direct transportation facilities, the unfortunate delays occurring in transshipment, the failure of exporters to meet the peculiar requirements of the particular foreign market sought, careless and improper packing, etc.—will be covered in reviewing that portion of the inquiry conducted after the close of the fiscal year to which the present report relates.

PLANS FOR THE CURRENT FISCAL YEAR.

Owing to the increase of work entailed upon the Section by the more numerous requests for information recently received, the time that can be given to the preparation of publications is considerably less than hitherto. Since the beginning of the present fiscal year such time as was available for this work has been devoted chiefly to the compilation of an exhaustive statistical report regarding the distribution of the agricultural exports of the United States during the five years 1894-1898. In this report the quantity and value of each product sent yearly to the various countries of destination will be given, together with some interesting summary statements showing the portion of our agricultural export trade that is controlled by the leading foreign nations. The report upon the distribution of the export trade will be followed by a somewhat similar statistical publication indicating the sources from which our agricultural imports were derived during the same period. Work has also been begun upon a bulletin that will embody some of the facts recently collected relative to the commercial possibilities of the Baltic Sea region. Another bulletin that has already been planned will have for its subject our foreign trade in agricultural products during the fiscal year 1899, following in its method of treatment the report published some months ago in reference to the agricultural imports and exports of the fiscal year preceding. Material is also being gathered for the preparation of several additional reports.

REPORT OF THE CHIEF OF THE BUREAU OF ANIMAL INDUSTRY.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
Washington, D. C., September 12, 1899.

SIR: I have the honor to submit herewith a report of the operations of this Bureau for the fiscal year ended June 30, 1899.

Respectfully,

D. E. SALMON,
Chief.

Hon. JAMES WILSON, *Secretary.*

WORK OF THE YEAR.

INSPECTION DIVISION.

MEAT INSPECTION.

The inspection of cattle, sheep, calves, and hogs, and their products, was carried on at 138 abattoirs and packing houses in 41 cities. This was an increase of 3 abattoirs and 6 cities over the previous year, and of 10 abattoirs and 8 cities over the fiscal year 1897. In 12 of the cities where inspection was carried on last year (Chicago, Kansas City, South Omaha, Milwaukee, Sioux City, East St. Louis (National Stock Yards), St. Louis, Indianapolis, South St. Joseph, Pittsburg, South St. Paul, and Buffalo) the ante-mortem inspection was made in the stock yards, and included animals purchased by miscellaneous buyers and those for shipment to other cities, as well as those for local official abattoirs. The inspection of horses was conducted at one abattoir only.

The following table gives the number of inspections made upon animals before slaughter. It also shows the number rejected upon this inspection, subject to the result of the post-mortem examination. The rigidness of the ante-mortem inspection is evidenced by the fact that upon examination at slaughter much the greater number of carcasses are pronounced fit for food. Many animals are rejected in the stock yards on account of pregnancy; these are allowed to be shipped out when desired for feeding or dairy purposes.

Ante-mortem inspections for fiscal year 1899.

Kind of animal.	For official abattoirs in cities where inspections were made.	For abattoirs in other cities and miscellaneous buyers.	Total inspections.	Rejected at abattoirs.	Rejected in stock yards.
Cattle.....	4,654,842	4,288,562	8,943,404	180	26,593
Sheep.....	5,718,464	3,819,920	9,538,384	476	18,150
Calves.....	245,859	253,404	499,263	41	3,128
Hogs.....	23,783,576	10,455,317	34,238,893	4,942	102,992
Horses.....	3,232		3,232	37	
Total.....	34,405,973	18,817,203	53,223,176	5,676	150,863

A comparison of these figures with several previous years will show how this work has progressed each year. The following table gives the total ante-mortem inspections for the fiscal years 1896 to 1899, inclusive:

Total number of ante-mortem inspections for four years.

Fiscal year.	Cattle.	Sheep.	Calves.	Hogs.
1896	7,529,523	6,318,284	314,846	21,754,826
1897	8,250,025	8,044,355	448,983	25,566,744
1898	9,228,237	10,028,287	468,199	31,610,675
1899	8,943,404	9,538,384	499,263	34,238,893

The number of animals inspected at time of slaughter, and the number of carcasses and parts of carcasses condemned and rendered so as to unfit them for consumption as food, are given in the following table:

Post-mortem inspections for fiscal year 1899.

Kind of animal.	Number of inspections.			Carcasses condemned.			
	For official abattoirs.	On animals rejected in stock yards.	Total.	For official abattoirs.	Animals rejected in stock yards	Total.	Parts of carcasses condemned at abattoirs.
Cattle	4,382,020	16,726	4,398,746	6,404	3,219	9,623	10,514
Sheep	5,603,066	6,023	5,609,119	3,369	1,476	4,845	359
Calves	246,184	935	247,119	199	105	304	45
Hogs	23,836,943	67,996	23,904,939	48,897	6,122	55,019	29,143
Horses	3,232		3,232	181		181	
Total	34,071,475	91,680	34,163,155	59,050	10,922	69,972	40,061

In addition to the condemnations upon regular inspection, as above given, there were 41,597 carcasses of hogs condemned upon microscopic examination for trichinæ. In accordance with the provisions of section 22 of the regulations governing meat inspection, about half of the meat from these carcasses was cooked, the rest being tanked.

For the purpose of comparison, the following table is given:

Number of animals inspected before slaughter for abattoirs having inspection, 1891-1899.

Fiscal year.	Cattle.	Calves	Sheep.	Hogs.	Horses.	Total.
1891	83,891					83,891
1892	3,167,009	59,089	583,361			3,809,459
1893	3,922,174	92,947	870,512			4,885,633
1894	3,862,111	96,331	1,020,764	7,964,850		12,944,056
1895	3,752,111	109,941	1,344,031	13,576,917		18,783,000
1896	4,050,011	213,575	4,710,190	14,301,963		23,275,739
1897	4,289,058	259,930	5,179,643	16,813,181		26,541,812
1898	4,552,919	241,092	5,706,092	20,713,863		31,213,966
1899	4,654,842	245,859	5,718,464	23,783,576	3,232	34,405,973

The number of animals that died of disease or injury, or were killed by city inspectors after rejection in the stock yards, added to those found dead in cars or pens at abattoirs and tanked, is shown in the table on the next page.

Number of different kinds of animals rejected for fiscal year 1899.

Manner of death.	Cattle.	Sheep.	Calves.	Hogs.	Horses.	Total.
Dead at abattoirs	235	1,059	36	19,424	43	20,797
Died in stock yards	309	1,121	105	2,301	-----	3,736
Killed in stock yards	1,296	784	176	21,274	-----	23,530
Total	1,840	2,964	317	42,899	43	48,063

Tag or brand affixed.—The meat-inspection tag or brand was affixed to 14,919,664 quarters and 217,920 pieces of beef, 5,522,142 carcasses of sheep, 225,348 carcasses of calves, 932,878 carcasses of hogs, and 551,331 sacks of pork.

Packages stamped.—The number of packages stamped comprised 4,840,834 of beef products, 9,417 of mutton, 12,545,965 of hog products, and 763 of horse flesh. The number of packages of hog products just given includes 393,838 packages which contained meat that had been microscopically examined in addition to the regular inspection.

Cars sealed.—The number of cars sealed which contained inspected meat for shipment to packing houses and other places was 47,455.

Certificates issued.—The number of certificates issued for meat products which had received the regular inspection, exclusive of horse flesh, was 42,237. The exports thus certified consisted of 1,428,290 quarters, 45,789 pieces, and 837,634 packages of beef, weighing 360,843,856 pounds; 9,417 packages of mutton, weighing 525,705 pounds; 109,505 carcasses and 880,324 packages of pork, weighing 278,696,435 pounds. Fourteen certificates were issued for 763 packages of horse flesh, weighing 347,048 pounds.

Cost of inspection.—The cost of this part of the work of the inspection division was \$465,709.23, which, embracing all the branches of meat inspection, makes an average of 0.88 cent for each of the 53,223,176 ante-mortem inspections.

The following statement shows the cost of each ante-mortem inspection from 1893 to 1899, inclusive:

	Cents.
1893	4.75
1894	1.75
1895	1.10
1896 .....	.95
1897 .....	.91
1898 .....	.80
1899 .....	.88

MICROSCOPIC INSPECTION OF PORK.

The number of carcasses examined was 2,227,740. The result of the examination was: Class A, free from all appearance of trichinæ, 2,160,230, or 96.97 per cent; Class B, containing trichinæ-like bodies or disintegrated trichinæ, 25,913, or 1.16 per cent; Class C, containing living trichinæ, 41,597, or 1.87 per cent.

The number of certificates issued for microscopically examined pork products was 22,708. The number of packages exported was 393,626, weighing 108,928,195 pounds. Of this quantity, 137 packages, weighing 70,046 pounds, went to countries not requiring a certificate of microscopic inspection.

The cost of the microscopic inspection was \$198,355.14, an average of 8.9 cents for each carcass examined and of 0.182 cent for each pound exported.

The apparent increase in the cost over last year is due in some measure to the necessity of increasing the force in order to maintain a more careful control of the stock of microscopic meats and of the cellars containing it, and to a more accurate system of charging employees to different accounts according to the kind of work performed, whereby a number of salaries which have heretofore been charged to general meat inspection have more properly been counted as part of the expense of the microscopic inspection.

INSPECTION OF VESSELS AND EXPORT ANIMALS.

The year shows a considerable falling off in the number of domestic animals exported to Europe. In the table following are given the number of inspections of American and Canadian cattle and sheep for export, the number rejected, the number of American cattle tagged, and the number of animals exported under the supervision of inspectors of this Bureau:

Number of inspections, etc., of American and Canadian farm animals.

Kind of animal.	American.				Canadian.		
	Inspec- tions.	Rejected.	Tagged.	Exported.	Inspected.	Rejected.	Exported.
Cattle.....	643,301	1,593	327,741	<i>a</i> 311,595	27,806	9	27,797
Sheep.....	174,717	118		<i>b</i> 98,551	37,247	41	37,206
Horses.....				26,351			2,685
Hogs.....				98			

a 14,786 from Chicago via Canadian ports.

b 4,757 from Chicago via Canadian ports.

The number of certificates issued for American cattle was 1,201. The number of clearances of vessels carrying live stock that had been inspected was 852.

The following table shows the number of animals inspected at time of landing by the inspectors of this Bureau stationed at the ports of London, Liverpool, and Glasgow, together with the number and percentage lost in transit:

Number of animals inspected at time of landing in London, Liverpool, and Glasgow, and loss in transit.

From—	Cattle.			Sheep.			Horses.		
	Landed.	Lost.		Landed.	Lost.		Landed.	Lost.	
	<i>Number.</i>	<i>Number.</i>	<i>P. ct.</i>	<i>Number.</i>	<i>Number.</i>	<i>P. ct.</i>	<i>Number.</i>	<i>Number.</i>	<i>P. ct.</i>
United States.....	294,318	911	0.31	97,659	1,526	1.54	20,035	224	1.11
Canada.....	24,295	<i>a</i> 504	2.03	34,003	<i>a</i> 1,639	4.6	1,808	5	0.28
Totals, etc.....	318,613	1,415	0.44	131,662	3,165	2.35	21,843	229	1.04

a 366 cattle and 441 sheep were lost by the wrecking of the ship.

The expense of inspection of animals for export, the supervision of the movement of Southern cattle, and the inspection of animals imported from Mexico amounted to \$107,023.41. Following the precedent of estimating half of this to be properly chargeable to the export

work, we find that the cost of inspecting the 410,146 domestic cattle and sheep exported was \$53,511.70, an average of 13 cents per head. The number of inspections of these animals in this country was 818,018, and in Great Britain 391,977, a total of 1,209,995, made at an average cost of 4.42 cents for each inspection.

SOUTHERN CATTLE INSPECTION.

During the quarantine season of 1898, 32,937 cars, containing 911,455 cattle from the area infected with splenic fever of cattle, were unloaded in the quarantine divisions of the stock yards at different points. There were 33,814 cars cleaned and disinfected.

In the noninfected area in Texas 236,369 cattle were inspected and identified by brands as originating north of the quarantine line and permitted to be removed to other States for grazing. In California 37,832 cattle were inspected prior to shipment to points outside of the infected district. In conjunction with the authorities of Missouri 684 cattle originating in the northern counties of Arkansas were inspected and permitted to be driven into Missouri.

PREVENTION OF SCABIES.

In order to prevent the spread of scabies among sheep, it was required that all sheep shipped from stock yards to other States for feeding purposes be dipped with some preparation that would kill the parasite. In pursuance of this order there were dipped 145,974 sheep that were infected and 526,970 that had been exposed to the contagion of the disease.

For many years the parasitic disease of sheep popularly called scab has been prevalent, especially in some of the Western States and Territories. Diseased sheep have been shipped in violation of the law, and stock yards and stock cars have been almost constantly infected. The result has been that sheep could not be purchased for feeding purposes in any of the markets of the country without danger of bringing the contagion to the farm with them.

Not only does sheep scab always damage and often destroy the fleece, but it so reduces the strength of the affected animals that they fall an easy prey to internal parasites or succumb to unfavorable conditions of food and surroundings. Congress has specifically referred to this disease in the appropriation act as one which the Department is authorized to control by sanitary regulations.

The first step taken by the Department looking to the limitation and control of this disease was by a circular letter notifying transportation companies and shippers of the existence of the contagion and pointing out the prohibition of shipment and penalty provided by the law. Subsequently an order was issued that diseased sheep discovered by the inspectors in transit or in infected yards should be detained and dipped before going on to destination.

The effect of these orders was to protect purchasers of store sheep and to lessen the number of diseased animals sent to market. It was found, however, that some of the dips used by stock-yards companies and sheep owners were not efficacious, and that others were so severe or poisonous as to be dangerous. An order has consequently been issued specifying the kinds of dips which would be recognized and the manner in which they should be prepared and applied.

The effect of these measures has been extremely satisfactory. The inconvenience of detention and the expense of dipping have had the effect of lessening the number of diseased sheep sent to market, and has led to active efforts to cure them on the farm or ranch before shipping. This has been accomplished without putting the shippers of healthy sheep to any inconvenience or expense unless these animals were going to farms from infected stock yards. The indications are at this writing that it will soon be possible to make the stock cars, the central stock yards, and other channels of interstate commerce safe and free from infection, in which case store sheep could be purchased in the markets without danger of infection, and only diseased sheep would come under the restrictions.

INSPECTION OF IMPORTED ANIMALS.

The inspection of animals imported from Mexico was made at the ports of entry along the boundary line, and included 79,908 cattle, 1,254 sheep, 64 swine, and 121 goats.

The imports from Canada of animals not subject to quarantine detention consisted of 90,468 cattle, 172,985 sheep, 1,769 horses, 194 hogs, 1 moose, 1 goat, and 11 mules. Of these, 425 cattle, 6,581 sheep, and 176 hogs were for breeding purposes.

Following is a statement of the number of animals imported and held at the different quarantine stations for the prescribed period:

Number of animals imported and quarantined at different stations.

Stations.	Cattle.	Sheep.	Hogs.
Littleton, Mass.	8	93	-----
Garfield, N. J.	335	405	45
St. Denis, Md.	6	-----	1
Houlton, Me.	483	315	2
Vanceboro, Me.	112	13	-----
Eastport, Me.	5	-----	-----
Newport, Vt.	241	-----	-----
Island Pond, Vt.	71	9	1
Beechers Falls, Vt.	19	5	-----
Richford, Vt.	43	-----	-----
St. Albans, Vt.	37	-----	-----
Ogdensburg, N. Y.	43	-----	-----
Cape Vincent, N. Y.	78	-----	-----
Buffalo, N. Y.	38	-----	-----
Port Huron, Mich.	43	-----	-----
Total	1,562	840	49

There were also at the Garfield station 12 camels, making a total of 2,463 animals quarantined.

PATHOLOGICAL DIVISION.

BLACKLEG INVESTIGATIONS.

The item of work which has consumed the most time in the pathological division has been the distribution of blackleg vaccine, including its preparation, shipment, and the correspondence incident thereto. During the year 6,200 letters on this subject were received, each of which required a reply and an application blank for vaccine. On return of the blanks properly filled up vaccine was forwarded and the applications properly indexed and filed. In many instances it was necessary to dictate special letters in reply to inquiries. Vaccine was sent out to the number of 545,289 doses. The following

statement shows the number of doses shipped for each month of the year:

July	19,555
August	26,305
September	3,820
October	47,487
November	69,365
December	68,260
January	50,629
February	41,145
March	29,823
April	89,575
May	44,670
June	54,655
Total	545,289

The comparatively small amount sent out in September was due to the fact that the supply was exhausted at that time. The more than half a million doses were sent principally into the States of Texas, Nebraska, Kansas, Colorado, North Dakota, New Mexico, South Dakota, and Indian Territory and Oklahoma Territory. Outbreaks of blackleg have occurred elsewhere, however, being reported from Virginia, West Virginia, Pennsylvania, Vermont, New York, Ohio, Kentucky, Tennessee, North Carolina, Michigan, Indiana, Illinois, Wisconsin, Minnesota, Iowa, Missouri, Washington, Wyoming, Montana, Oregon, Idaho, Utah, California, Arkansas, and Arizona. It appears, therefore, that this disease may prevail in any section in which cattle raising is an extensive industry.

Dr. Victor A. Nörsgaard, chief of the pathological division, has published an article in the annual report of this Bureau for 1898 on "Blackleg in the United States and the distribution of vaccine by the Bureau of Animal Industry," which gives a résumé of the work so far accomplished by the Bureau, the history of the disease in this country and in Europe, and the geographical distribution of the disease in the United States. Dr. Nörsgaard estimates that the annual loss of cattle from blackleg in the districts principally affected has ranged in years when the disease was most prevalent from 5 to 35 per cent. The estimated loss after inoculation with the Bureau vaccine was 0.54 per cent inoculated, or a little more than one-half of 1 per cent. This percentage would have been still further reduced, no doubt, had the operators been familiar with the work of vaccination. In fact, the reports received state that losses, when they occurred, were due to failure to follow instructions carefully. This rather remarkable record indicates the perfect safety of the method pursued when the fact is known that nearly all the inoculations were made by inexperienced persons.

The distribution of vaccine is being continued by the Bureau, and adequate measures have been taken to permit the sending of the vaccine immediately on receipt of the application. It is advisable that all stock owners in infected districts should vaccinate their young stock regularly, without awaiting an outbreak of the disease, as heavy losses may be sustained in the course of a few days. The Bureau can not, however, undertake to keep stockmen supplied with vaccine simply for the purpose of keeping it on hand for use in case of an outbreak.

TEXAS FEVER.

It is a matter of congratulation that the method of producing immunity from Texas fever by inoculating with the blood of immune

animals, as first practiced and proved efficacious by this Bureau, has been used practically with highly satisfactory results by the State Agricultural Experiment Station of Missouri. That station has very properly taken the matter up and has permitted its veterinarian to make the inoculations as a means of insuring the safety of pure-bred stock from Missouri sold for improving the herds in the Texas-fever district. The losses from the operation are understood to be insignificant, and the inoculated animals have been able to resist almost perfectly the effects of exposure to the contagion after their arrival in the infected district. The practical application of this discovery is of great importance, both to the breeders of improved stock in the more Northern States and to the cattle raisers of the infected district. It permits the improvement of the Southern herds without the discouraging losses which have heretofore always occurred, and no doubt it will lead to the rapid grading up of the cattle of the South and Southwest, increasing materially the numbers and values.

THE TEXAS-FEVER TICK IN THE WEST INDIES.

The new and more intimate relations which have been established between the United States and some of the islands of the West Indies have led to the inquiry as to whether these islands are permanently infected with Texas fever, as is the southern portion of the United States and the coast regions of Mexico. Information received from Jamaica has long since led to the conclusion that that island is permanently infected. The large numbers of cattle taken to Cuba from the infected districts of the United States, Mexico, Central America, and South America have unquestionably infected the larger part of the island, even if it had previously been free, which is unlikely.

Reports from Porto Rico indicated that but a comparatively small number of cattle have recently been imported, and the quality of some of the native cattle seemed to favor the assumption that the fever contagion had not been introduced. To determine this, an inspector of the Bureau, Dr. Rice P. Steddom, was instructed to proceed to Porto Rico and make a careful investigation. Dr. Steddom traversed a large portion of the island and found the cattle everywhere infested with the *Boophilus bovis* tick, the presence of which in the United States is prima facie evidence of infection with Texas fever. When the offspring of the Porto Rican ticks were placed upon cattle at our experiment station, however, no disease was produced. The question therefore is still unsettled as to whether the *Pyrosoma*, the true contagion of the disease, exists in Porto Rico. It is well known that the *Boophilus* acts only as the carrier of the *Pyrosoma*, and that the former may exist in a district without the latter, and, conversely, the latter may exist without the former. It is only when both are present that the disease exists in a contagious form. The importance to the cattle raisers of the island of having this question speedily and definitely determined is apparent. If the *Pyrosoma* does not exist there, measures should at once be adopted to prevent its entrance. The tick being certainly prevalent, the introduction of a single cow or steer bearing the *Pyrosoma* might convert these comparatively harmless parasites into the most deadly scourges of the bovine race.

GLANDERS.

Four cases of glanders occurring within the District of Columbia and one from Wyoming were diagnosed in this division. In November Drs. A. D. Melvin and V. A. Nørgaard investigated an outbreak among the Army horses at Jacksonville, Fla. A report was made to

Maj. Noble H. Creager, quartermaster, embodying recommendations such as are required for the eradication of the disease.

RABIES.

Inoculations of rabbits from sixteen suspected rabid dogs showed ten cases of rabies in the District of Columbia as coming under the notice of the division. Another case came from South Carolina. In two of the cases diagnosed, four persons were reported to have been bitten by the dogs affected. The method of diagnosis employed in these cases is given in an article which appeared in the volume comprising the Twelfth and Thirteenth Annual Reports of this Bureau.

INFECTIOUS LEUKÆMIA IN FOWLS.

Several outbreaks of infectious leukæmia in fowls were investigated. One case was from Virginia and another from Wisconsin, thus showing the widespread distribution of the disease. This is a bacterial disease, and is frequently mistaken for fowl cholera. Investigations concerning this disease have been reported quite fully by Dr. Veranus A. Moore, in the Twelfth and Thirteenth Annual Reports of this Bureau, and further information is contained in Bulletin No. 8 of the Bureau, and in the Fifteenth Annual Report.

ASTHENIA IN FOWLS.

Asthenia in fowls, sometimes called "going light," is discussed by Dr. Charles F. Dawson, in the Fifteenth Annual Report of the Bureau. Dr. Dawson believes he has discovered the cause of the disease to be a bacterium which he has described and named *Bacterium asthenie*. During the year two outbreaks were investigated, one in fowls and the other in pigeons.

WILD UND RINDERSEUCHE.

During the past summer an outbreak of a disease supposed to be identical with the Wild und Rinderseuche of Germany was reported from Tennessee. The Bureau directed Dr. John R. Mohler to proceed to the seat of the outbreak and investigate the cases. His investigations gave no evidence of the presence of this contagious European disease.

MISCELLANEOUS WORK.

Specimens for diagnosis.—Many specimens are received annually at the laboratory from various sources. During the past year the following diagnoses were made: Melanosis, pneumonia, actinomycosis, tuberculosis, hog cholera, enteritis, blackleg, Texas fever, osteosarcoma, lipoma, fibro-lipoma, and adeno-carcinoma. Each of these specimens requires much laboratory work with the microscope, sometimes a week being devoted to a single specimen; in each case also a careful record is made and full reply returned to the sender.

Bacterial cultures.—A collection of about fifty species of bacteria has been maintained, and quite a number of cultivations made from them have been prepared and sent to scientific schools and colleges upon request. This is one of the Bureau's means of disseminating information, and appears to be much appreciated.

Special students.—During the year two gentlemen have taken courses of special instruction in the laboratory of the pathological

division, namely, Prof. L. L. Lewis, of the Oklahoma experiment station, who has studied the preparation and use of blackleg vaccine, and Prof. E. F. Pernot, bacteriologist of the Oregon experiment station, who has had opportunities for instruction in most of the lines of work pursued in this division. The Bureau furnishes equipment and has facilities for such work which it is difficult to find elsewhere in this country. The benefit the Bureau may in this way render to the country at large is obvious.

Increased facilities.—The laboratory building has been enlarged during the year, affording two new rooms, which have been much needed. One of these will be devoted to histological research and the other to the preparation of blackleg vaccine.

BIOCHEMIC DIVISION.

TUBERCULIN AND MALLEIN.

The routine work in the preparation of tuberculin and mallein has continued during the past year. These products are furnished only to local authorities for official use. The quantity of mallein sent out to State officials and experiment stations has been sufficient to test about 5,200 animals. The quantity of tuberculin sent out during the year was sufficient to test about 36,000 animals.

STAMPING INK.

In addition to other work this division has continued to prepare and supply ink suitable for stamping meat in such quantities as required by the inspection division.

SERUM FOR HOG CHOLERA AND SWINE PLAGUE.

The work of preparing serum for treating the diseases of hog cholera and swine plague has been conducted on a very much larger scale than last year. The results of last season's work were exceedingly satisfactory, and the number which would serve as a source of serum has been largely increased. During the present year a force of inspectors has been at work in four counties in Iowa treating a large number of animals and endeavoring to keep down, so far as possible, by the serum treatment, the amount of disease among the swine. While it is impossible at the present time to give positive results in connection with this work, it appears from the reports that have been sent in that we may expect about the same results as those obtained in Page County, Iowa, during the past year.

The work in connection with the preparation of antitoxin in such large quantities has been very heavy, both in the laboratory and at the experiment station of the Bureau. It requires a considerable number of employees to prepare the necessary cultures which are to be used in injecting the animals, to draw the serum, have it properly bottled and shipped, and at the same time to control the outbreaks in the West. Cultures are taken from each herd that is treated in the West when an autopsy is made upon some of the sick animals. These cultures are examined and tested. In addition, specimens of serum from each herd are used for the application of the motility test, and every care is taken to demonstrate so far as possible the exact character of the disease which exists in the herds that are being treated. Many problems of scientific interest have arisen in connection with this work, the elucidation of some of which will be of great practical

importance. So far as possible, investigations of these points have been made as the routine work was progressing, or a careful note taken of them, and they will receive more careful study when the routine work of the laboratory will permit and when increased assistance has been secured.

MISCELLANEOUS WORK.

Some examinations of butter, from a hygienic standpoint, have been made for the dairy division, and also other miscellaneous investigations, as the work of the Bureau demanded.

INTERNATIONAL TUBERCULOSIS CONGRESS.

As the general study of the diseases of men and animals progresses it becomes more and more evident that the final solution of many difficulties depends upon a careful biochemic study of diseases. This appears to be the case, not only with the diseases which the division has been studying for some years, but also with Texas fever, diseases of fowls, and many other diseases. The very intimate relationship which exists between the diseases of men and animals, and the dangers to which animals may be subjected from like diseases of men, deserve very special investigation. For this reason, in May last, the chief of the biochemic division was sent to Berlin for the purpose of attending the International Tuberculosis Congress. Over two hundred prominent men were present at this congress as delegates from twenty-five nations. The congress was under the patronage of the Empress of Germany, and there were more than two thousand members. The papers presented by many of the most prominent men in all lines of medical, bacteriological, and hygienic work were exhaustive in character, reviewing very thoroughly the knowledge of tuberculosis from all standpoints at the present time. They will serve as an excellent basis for continued investigation and work in the future. Papers by Virchow, Bollinger, and others emphasize the dangers of meat and milk from tuberculous animals. It appears that indirectly very many practical results for the benefit both of men and animals will follow from the work of this congress.

As it was the fortune of the chief of the biochemic division to meet at that congress, and afterwards in visiting the most important anti-toxic serum laboratories and stations in Europe, the most prominent workers in biochemic lines, it seems right that attention should here be called to the high regard in which he found the scientific work of the Bureau of Animal Industry to be held by investigators in similar lines in the different European states. It is a great advantage to the work of the Bureau and the Department to have its scientific employees meet personally the investigators in similar lines, thus affording the opportunity of exchange of ideas and the planning of cooperative work.

PROPOSED WORK FOR NEXT YEAR.

For the next year it is proposed to continue in the biochemic division the routine work which has already been referred to, and in addition, to take up as many new problems as the laboratory facilities and the number of assistants at work will allow. In connection with this routine work it will be necessary for the division to examine numerous samples of dips used for treating diseased sheep that are subjects of interstate commerce in order to ascertain if these dips have a satisfactory percentage of active ingredients to be recognized as efficient remedies.

Insecticides and germicides.—The chief of the biochemic division has also been appointed as reporter on insecticides and germicides by the Association of Official Agricultural Chemists. His efforts in this work will be to suggest such methods for the examination of insecticides and germicides as will be thoroughly reliable and serve to indicate their actual value.

THE EXPERIMENT STATION OF THE BUREAU.

PRODUCTION OF HOG CHOLERA AND SWINE PLAGUE SERUM.

Investigations relative to the production of hog cholera and swine plague serum have been continued at the experiment station of the Bureau. The results obtained in the past from serum prepared by the station, working in conjunction with the biochemic division, have afforded much encouragement and have justified the continuation of the work on a much larger scale. The attempt is being made to produce a sufficient amount of antitoxic serum to treat all the hogs affected with or exposed to hog cholera or swine plague in a territory embracing four counties specially selected for experimental work, so that the final deductions concerning the value of the serum treatment for these diseases may leave no room for adverse criticism.

The portion of this work assigned to the experiment station consisted in the selection of proper animals for supplying the serum, and also the care, preparation, and treatment of these animals throughout the course of the experiment. A thorough effort is being made to find the species of animal best adapted to furnish this serum, and also the best method of administering the cultures of bacteria and the products of cultures to give the serum of the animals an antitoxic value. It is also designed to find the best and least expensive treatment of the unfavorable conditions which frequently follow the injection of cultures of disease-producing bacteria. Cultures of various ages, in combination with a variety of drugs and under a variety of conditions, have been used, and always with one object in view, namely, to obtain the most active antitoxic serum at the least possible cost and with the least inconvenience to the animal supplying it.

While the treatment of hog cholera and swine plague with antitoxic serum has proved to be of great value, and further investigations along this line will be made, the possibility that a method may be discovered by which these two important diseases can be treated successfully without the intervention of a serum animal has not been overlooked. Experiments in this direction are now being made, and while they have so far given no very encouraging results, it is desirable that they should be continued.

ANTITOXIC SERUM FOR TUBERCULOSIS.

Experiments to produce an antitoxic serum for the treatment and prevention of tuberculosis are also in progress, the work being done by the station in cooperation with the biochemic division.

TEXAS FEVER INVESTIGATIONS.

Much time and attention has been given to the Texas fever question. It is desirable that the method developed by the Bureau for immunizing Northern cattle which are to be shipped into the South

should be improved. The same observation is true of the dips now in use for destroying ticks (*Boophilus bovis*) on Southern cattle.

The immunizing feature has been undertaken by studying the effects produced by the injection of blood serum from Southern cattle into Northern cattle. Much remains to be done in this line. The seeming difference in severity of the infection produced by the injection of blood obtained from different Southern cattle and the difference existing between the virulence of Texas fever in different portions of the so-called permanently infected areas are conditions requiring investigation.

The importance of discovering a dipping mixture through which Southern cattle may be passed to kill the ticks upon them and thus remove the danger of spreading Texas fever has not been lost sight of, but unfortunately all mixtures used have proved inefficient. A number of different dips are now being tested at the station, and the effects produced on both the cattle and the ticks are carefully noted. Laboratory tests are also being made, and there is still reason to believe that success will eventually be attained.

A lot of cattle ticks from Porto Rico were tested to determine whether they carried the infection of Texas fever, but a negative result was given. The ticks were found to be in all respects like our native cattle tick, with the exception that our ticks are a trifle larger and a little more oval (less circular) in outline.

PREPARATION OF BLACKLEG MEAT.

During the early portion of the year a considerable amount of blackleg meat was prepared at the station to be used by the pathological division in the manufacture of blackleg vaccine. Much of this vaccine was subsequently tested at the station.

OUTBREAK OF TETANUS.

During the latter part of the year the station suffered an outbreak of tetanus, or lockjaw. The infection was confined entirely to the animals used in serum experiments. This unhappy circumstance was turned to the best advantage by using it as an opportunity to test the value of serum treatment as applied to lockjaw. All the animals which had been exposed to the disease were injected with an immunizing dose of tetanus antitoxic serum, and the animals already affected were also treated with the serum. Among the animals which received an immunizing dose (horses, mules, donkeys, and cattle, over 100 in all), only one subsequently suffered with tetanus. This animal became affected within thirty-six hours after the serum was injected. It was a donkey, and was probably affected at the time the injection was made and hence derived no benefit from the serum. The treatment of tetanus, or lockjaw, once the symptoms are well developed, either by hypodermic or introcranial injections of serum, accompanied by large doses of chloral, morphine, or chloroform inhalations, merely serve to prolong life a few days. Treatment of the wound through which the tetanus bacillus gained entrance to the body was almost out of the question, because of the difficulty of locating the wound. In only one instance was the injection of material from the suspected seat of infection into a rabbit followed by a transmission of the disease. From this it is to be concluded that it would be wise for the experiment station to be provided with two or three tetanus antitoxic

serum animals, to guard against further losses from the disease, and also to determine whether a serum of sufficient strength can be produced to have a positive value as a curative agent.

During the past two years the experiment station has labored under some disadvantages. Two years ago the location of the station was changed to its present site, and in addition to the regular routine and special scientific work, there was added the work of planning, and, in a great measure, constructing the numerous equipments and appliances which are essential to the class of investigations which are being conducted. The year ended in a very gratifying manner, with the purchase of the property now used for this station, and hereafter it will not be necessary to abandon improvements and build anew on account of the expiration of a lease. This is a great encouragement to those engaged in the scientific work.

DAIRY DIVISION.

COLLECTING AND DISSEMINATING INFORMATION.

A general survey of the condition of the dairy industry of the country at large was begun upon the organization of the division. This has been continued and special inquiries have been made in some branches, as, for example, the milk supply of cities and towns. Some reports have been printed and others are in hand awaiting revision and publication.

The division continues to collect dairy data in general, with a view to its proper arrangement and further use. So far as the clerical force of the office permits, the material collected has been indexed for ready reference. This particular work, however, is always much in arrears.

The current correspondence, with calls for specific information, together with other routine work of the office, is continuously increasing. This includes the preparation of reports and other manuscript for publication.

During the year five distinct publications have been prepared in the division, comprising in all 136 pages. Of these, two are included in the Fifteenth Annual Report of the Bureau, one of which was ordered to be revised and issued as a Farmers' Bulletin. Former publications of the division have been so much called for as to necessitate some revision and the reprinting of large editions.

VISITING DAIRY CENTERS.

The practice of visiting dairy centers and attending the annual conventions of State dairy associations and similar bodies has been continued, so far as the home duties of the chief and assistant chief of the division have permitted. In order to extend this service, in accordance with the policy of the Department, special agents were temporarily employed. Messrs. John H. Monrad and D. W. Willson, both of Illinois, served in this capacity. In all, twenty States have thus been visited by representatives of this branch of the Department. In this way hundreds of men actively engaged in the dairy industry have been met and consulted in different parts of the country and personal relations established which will be of material benefit in future work.

EXPERIMENTAL EXPORTS OF BUTTER.

Under authority given in the annual appropriation act of Congress for this Department, and the special provision made therein for the purpose, this division has had the supervision of a series of experimental exports of butter and cheese. This has been in continuation of the work of 1897-98, as already reported, but upon a plan enlarged and diversified. In this connection special agents of the Department have visited Great Britain, France, Germany, China, Japan, the Hawaiian Islands, and the Philippine Islands, and made arrangements for experimental exports to places in all these sections of the globe.

Trial shipments to Germany and France demonstrated that the markets for choice dairy products from America were by no means as good in those countries as in Great Britain, while the difficulties in transportation and the import duties imposed added to the disadvantages experienced. Accordingly, the experimental exports, made almost every week during the year 1898, and weekly until the summer of 1899, were confined to England, and mainly to the market of Manchester. The desired information having been obtained by these experiments, extending through the greater part of three years, they were discontinued in May, 1899. Then work was immediately begun upon similar exports from San Francisco to Pacific ports. No results from the latter can yet be reported.

The series of weekly experimental exports of selected creamery butter to Manchester, England, for more than a year, was highly satisfactory. A group of retail merchants in the north of England was thus supplied regularly with this grade of butter from the United States, so that they had it continually on hand for their customers. The result was that a good reputation was well established for American butter in that district, and the merchants, during the latter part of the trials, urged the shipment of larger quantities. Excepting an occasional variation from the standard, and a few instances of deterioration incident to imperfections in the facilities for transportation, this butter was eminently satisfactory to the merchants and consumers, and replaced Danish butter of first quality, which had been previously used. It was commonly retailed at the price of the best Danish, although the merchants demanded a slight concession in what they paid, as an inducement to take the American article instead of the standard product of Denmark and Sweden, to which they had so long been accustomed. When the experimental shipments were discontinued, the Manchester receivers expressed great disappointment, saying that the United States creamery butter had then made such a place for itself in their market, and was so regularly in demand by the retailers, that they desired to continue their supply. Application was accordingly made for the addresses of large creameries, or their selling agents, from whom fine butter in quantity could be obtained. British merchants subsequently made offers directly to manufacturers in this country for large quantities, and the only question about extending this trade was the relative prices of the highest grade of butter on the two sides of the Atlantic.

During the fiscal year covered by this report the domestic markets of the United States offered such prices for all the butter product of high grade of this country as to preclude exports upon a commercial basis. The details in connection with these experimental exports to

Great Britain during the fiscal year 1898-99, and which included cheese and eggs, as well as butter, will be made the subject of a special report by the dairy division.

PROPOSED WORK FOR NEXT YEAR.

The work of the dairy division for the fiscal year 1899-1900 is expected to include a continuation of the different lines of effort above reported.

The experimental exports will require a large share of the attention of the working force and probably necessitate the employment of a special agent on the Pacific coast. Exports to Pacific ports, although less frequent than those to England, will involve much detail and a much longer time for obtaining results.

Refrigerated transportation can not be furnished by the steamship lines on the Pacific, and this may not be desirable at present, as cold storage is not to be found at most of the Oriental markets. It will be necessary, therefore, to send all butter, and perhaps cheese also, as well as canned and condensed milk and cream, in hermetically sealed packages, capable of preserving their contents during long voyages and in hot climates.

The art of canning butter so that it will remain in good condition for months, and when subjected to great changes of temperature, has not yet been brought to perfection in this country. Incidentally it is desirable to give considerable attention to this subject for the benefit of exporters and those who wish to prepare butter for export to markets in warm countries.

An obstacle to successful competition in this trade is the fact, well established, that butter made in some other countries and found in the new markets referred to, has a firmer body and higher melting point, and consequently "stands up" better when the packages are opened than that which is made in the United States. Investigations show that certain feeding materials for cows have a specific effect upon the hardness of butter made from their milk. More definite information on this subject is needed, however, and it is hoped that this division may, by cooperation with agricultural experiment stations and otherwise, do something toward determining the particular kinds of food which are available in different parts of the country and which can be depended upon to regulate, to a considerable degree, the composition of the butter fat in milk, and hence the texture of butter.

Besides experimental exports in which the dairy industry of the Pacific coast should be particularly interested, it is proposed to ascertain the prospects for extended trade in dairy products in Mexico, the West Indies, and South America.

Through the courteous cooperation of the State Department a general inquiry has been undertaken, with a view to learning more than is now accurately known as to the production, consumption, and commerce of dairy products in all parts of the world.

Under instructions which have been issued, the chief of the dairy division will procure and superintend the arrangement and display of suitable material for a collective exhibit of the dairy industry of the United States at the Paris Exposition of 1900.

LABORATORY FACILITIES.

For a number of years the laboratories of the Bureau have been located in a rented building, giving insufficient space and exposing all the valuable material to danger of destruction by fire. In May last, the owner of this building consented to erect an addition, which has increased the facilities of the laboratories materially. The increasing demands for laboratory work, and the constant accumulation of specimens, card indexes of literature, apparatus, etc., makes it extremely desirable that a laboratory building should be erected upon the Department grounds especially adapted to the needs of this Bureau. As an example of the importance of a fireproof building, it may be stated, the zoologist of the Bureau in his studies of animal parasites, found the classification of many of them so defective that it was impossible to tell with what species the European investigators had been working. The life history of the organisms and the remedial measures required were uncertain, and the whole subject was in confusion. In order to obtain a basis for satisfactory work it was necessary to obtain from the various museums of the world the type specimens from which the original description of species were made. Some of these specimens were more than a century old, and it is plain that if they should be destroyed by the burning of the laboratory they could never be replaced. Their loss would be not only a loss to this country but to the world. It does not appear to be right to imperil such material, and yet it must be brought to our laboratory and used if we are to make progress in the study of these numerous forms of life which constitute one of the factors that must be considered in the successful development of our animal industry.

Again, the card indexes which we now possess relative to the literature of the world concerning diseases and parasites of animals have been in preparation for at least a decade and are now very perfect. These are necessary to creditable scientific work, because no man can make satisfactory researches without knowing what has already been done in the same line. If these indexes should be destroyed, they could not be replaced except by the same slow and tedious process by which they have been built up. A fire in the laboratory would therefore mean an enormous loss of time and a most discouraging interruption of the scientific work.

I would therefore most earnestly recommend that this matter be presented to Congress, with an appeal for early action, to secure such laboratory facilities as are commensurate with the great work of this Department in behalf of the agricultural industry.

The laboratory of this Bureau has not been in any sense a drain upon the resources of the country, but has, in addition to its scientific investigations, furnished products, such as tuberculin, mallein, black-leg vaccine, and hog cholera serum, of a value far beyond the total expenses incurred. These products have either been furnished to State authorities as the best available means of cooperation for the control of contagious diseases, or they have been used in the service as a method of eradicating or curing such maladies. Considering the expenditures that are now made for rent, the safety of Government property and material, and the increase of work that could be accomplished with better facilities, it would appear that such a building as is referred to would be from all points of view a most desirable acquisition.

SPECIAL RECOMMENDATIONS FOR 1900-1901.

The following recommendations are respectfully made:

(1) That the meat inspection force be increased until all the meat which is shipped from one State or Territory to another, or to a foreign country is thoroughly inspected. At present there are numerous applications for inspection which can not be favorably acted upon on account of the insufficiency of the appropriation.

(2) That measures for excluding sheep affected with scab from the channels of interstate commerce be rigidly enforced. This disease is a very annoying one, causing heavy losses to the sheep raisers, and has been largely spread through interstate shipments. Infected yards and cars should be disinfected, diseased sheep in transit should be quarantined and either slaughtered at once or dipped in a reliable mixture before being allowed to proceed. Sheep scab, although a very injurious disease, is easily cured and should be eradicated from the United States, as it has been from Australia.

(3) That the distribution of blackleg vaccine be continued a sufficient time to determine whether the prevalence of the contagion is lessened by the systematic vaccination of the cattle in the infected herds for a series of years. There is some reason for the opinion that if the disease is prevented by vaccination the contagion will gradually die out. The objection has been raised by the dealers in vaccine that this Department should not injure their business by making and distributing vaccine free of charge. The reply to this objection is that the Department can not take measures for eradicating any diseases without interfering with the business of those who are dealing in remedies for such diseases; and that, nevertheless, these animal plagues can not be allowed to ravage the flocks and herds of the farmers indefinitely in order to keep up the market for vaccines and other remedies. The price charged for vaccine by commercial concerns has been thirty to fifty times the cost of manufacture, and, at this exorbitant rate, the majority of stockmen would not use it. The vaccine distributed by the Bureau has apparently been more freshly prepared and has given better results. It has rapidly interested cattle raisers in this method of prevention, and the demand for it is increasing. The State experiment stations should be encouraged to make and supply this material to the stockmen of their particular States.

(4) That a special effort be made to instruct representatives of the State experiment stations in the manufacture and use of the anti-toxin for hog cholera and swine plague. This, in connection with the formula published in Farmers' Bulletin No. 24, constitutes the best treatment for these diseases, and saves an average of 70 to 80 per cent of the hogs in infected herds. The Bureau has demonstrated the efficacy of the treatment, and it is now for the stations and commercial houses to supply the serum. The Bureau can not possibly undertake to supply this product, except perhaps in small quantities to experiment stations, since it has not the facilities for manufacturing it upon the scale that would be required to grant relief to the different sections of the country.

(5) That the Texas-fever regulations be so amended as to prevent the movement of tick-infested cattle to the noninfected regions immediately above the quarantine line at any time of the year. The infected district is being extended in some directions by the gradual advance of the ticks which are carried by cattle crossing the line in

the open season. There is little doubt but that many counties in Arizona, New Mexico, Texas, Oklahoma, Kansas, Missouri, and Tennessee which are now free from infection are liable to become infected by the unrestricted movement of tick-infested cattle. With the States farther north this liability does not exist, and hence there must be a distinction drawn between cattle from the infected district which are to be fed immediately north of the quarantine line or in the more remote sections. This change in the regulations will require more inspectors, but it will be of great advantage, particularly to the Southern part of the country.

(6) That the experiments in dipping cattle with a view of destroying the ticks be continued. There has been no other practicable plan suggested for the treatment of cattle from the infected district that would render them safe to mingle with susceptible stock. The dips heretofore used have not proved reliable and have been so irritating as to injure the cattle. The dipping has consequently been suspended pending the discovery of a more satisfactory mixture.

(7) That pure-bred cattle imported into the United States for dairy or breeding purposes be tested with tuberculin and that those which react upon this test be rejected. The cattle of European countries are much more extensively diseased with tuberculosis than are those of the United States, and the increase of the disease here is undoubtedly largely due to the importation of the contagion with animals brought across to improve our stock. The control of the disease has become a serious problem in many States and a considerable number of such States are enforcing measures at great expense for its eradication. Under the circumstances the Department should certainly enforce the law for the exclusion of diseased cattle.

(8) The disinfection of hides to guard against the importation of the various forms of contagion which affect cattle, and particularly that of anthrax, has been one of the most serious problems about which the Bureau has been called upon to give advice. The law only prohibits the importation of the hides of neat cattle liable to be diseased, and provides for regulations to be made by the Secretary of the Treasury. The fact that the hides of other animals are as liable to bring disease as are those of cattle constitutes a defect in the law which at best prevents thoroughly efficacious measures. The attempt to disinfect hides from dangerous regions has shown that the satisfactory disinfection of hides without damaging them is a very difficult matter, and also that the measures of disinfection prescribed are for the most part either avoided entirely in foreign countries or are carried out in the most perfunctory and imperfect manner. Notwithstanding the numerous outbreaks of anthrax among people and animals which have occurred from such hides, it appears best to withdraw the requirement for disinfection abroad and to rely upon the total exclusion of cattle hides from countries where contagious diseases exist or to establish modern disinfecting plants at the principal ports of import.

(9) That the current provision of the annual appropriation act of this Bureau for developing and extending foreign markets for dairy products of the United States be continued, and with such changes in amount and phraseology as may be necessary to enable thorough investigation at home and abroad of making, packing, and shipping butter and cheese for use in hot climates.

(10) That the recommendations already made from this Department for necessary legislation to extend the existing system of Government inspection and certification of meats and meat products for export, so as to include butter, cheese, and condensed milk and cream for export from the United States be repeated and urgently pressed upon the attention of Congress. Reasons for such new legislation become more and more apparent. To those given in reports of previous years the following may be added: The work of this Department during several years, and involving the expenditure of much labor and money, to establish a reputation abroad for American dairy products will soon be destroyed without some such system of export inspection to safeguard reputation secured. Not long ago, through ordinary commercial agencies, this country practically supplied and controlled the cheese market of Great Britain. In some years we sent to England nearly 150,000,000 pounds, or two-thirds of our entire cheese product. Then, for the sole reason that no system of export inspection existed to guard the reputation gained, unscrupulous merchants, for mere temporary profit, exported great quantities of inferior and counterfeit cheese, until the reputation of States cheese was destroyed in England and that market lost to us. Canada, on the other hand, established a system of government control, was enabled to guaranty all cheese exported as pure and of standard quality, and thus gained and still holds the desirable British cheese trade which this country lost. As already explained, the recent work of this Department has materially aided in establishing a good reputation for States creamery butter in Great Britain. Our butter is in demand, especially in the northern counties supplied from Manchester, because of this reputation for fine quality. But this good work is already being undone. During the summer of 1899 an exceptional scarcity of European butter and consequent high prices in England have stimulated exports from New York. At the present writing it seems probable that this country will send to Great Britain this season several times as much butter as last year. During the month of August (1899) our butter exports were six times as great as for the same month a year ago. The receipts at Manchester, from this country and Canada combined, in some recent weeks have almost equaled those from Denmark. This new and profitable demand for good creamery butter had scarcely begun before large quantities of butter of inferior quality, also of "process," or renovated, butter, began to appear among the exports. The article last named, which is a more dangerous counterfeit than straight oleomargarine and butterine, has been sent to Liverpool via New York by the carload, put up in the style of package adopted by this Department in its export trials to England, and labeled "Finest American creamery butter." The effect upon future butter trade with Great Britain will probably be like that which followed the export of so much filled cheese. This misfortune could have been prevented and renovated butter forced to enter British ports under its true color had the authority for export inspection been granted last year, as was recommended by the Secretary. This proposition has been indorsed by nearly all the large conventions of representative dairymen recently held in this country, and it has met with decided approval by commercial bodies and by individual exporters wherever it has been duly considered.

REPORT OF THE STATISTICIAN.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF STATISTICS,
Washington, D. C., October 1, 1899.

SIR: I have the honor to submit herewith a report of the work of the Division of Statistics for the fiscal year ending June 30, 1899.

Respectfully,

JOHN HYDE,
Statistician.

Hon. JAMES WILSON, *Secretary.*

WORK OF THE YEAR.

The condition of the agricultural industry, as indicated by the area of land devoted to the cultivation of the principal products of the soil; the actual volume of production and the value of particular crops, both on the farm and in the principal markets; the cost of production per acre and per unit of quantity and the cost of transportation; the number and value of farm animals and the losses annually resulting from disease and exposure; the volume, condition, and prospects, according to the season of the year, of such of the crops of foreign countries as compete with those of the United States in the world's markets, have constituted the field of investigation in which this Division has been engaged during the past year.

STATISTICAL REPORTS.

Of the regular periodical reports of the Division, there has been printed a total of 1,621,700 copies. These reports cover that general work of the Division which is continuous in its operation and which has constituted for a generation or more the only source of information available to the farmer that has been comprehensive, prompt, and unbiased.

The special reports completed during the year relate to the cost of cotton production and to city and country taxation. The former was based upon returns from 3,446 representative plantations, distributed through the various cotton States in general accordance with their rank in the scale of production. Upland and sea island, large and small, fertilized and nonfertilized, profitable and unprofitable plantations were included in the investigation, the result being an amount of information relative to the cotton-growing industry under a variety of conditions that can not fail to prove of the utmost value. The report on "City and country taxation" consists of a comparison between assessed valuation and true values, as determined by actual sales and careful estimates, and an analysis of assessments, showing,

both for urban and rural districts, the proportion of the whole property tax paid upon each class of property. The investigation upon which this report is based was undertaken, not for the purpose of either sustaining or disparaging any particular economic theory or system of taxation, but solely for the ascertainment of facts bearing upon certain questions of especial interest to farmers, which are frequently raised in economic discussions, but have never been authoritatively settled.

An investigation into the extent and results of the application of the principle of cooperation to irrigation, farm and live-stock insurance, the distribution of agricultural products, the purchase of non-agricultural commodities, and in other directions in which farmers have interests in common, is well advanced, and it is expected that some definite results will be available for publication in a short time. In view of the extent to which the consolidation of industrial enterprises and other combinations of capital are engaging public attention, an inquiry into the extent to which the same principle is being applied among farmers can not fail to be of timely interest.

THE CROP-REPORTING SYSTEM.

No change of essential or far-reaching importance has been made during the year in the methods of collecting agricultural statistics, but there is a marked improvement in all the different agencies employed, the monthly reports being more complete, giving evidence of greater care in their preparation and generally displaying a more intelligent conception of the requirements of the Department on the part of its correspondents.

At the end of the fiscal year the organization included 41 salaried State statistical agents, with 8,730 correspondents, upon whose reports their monthly statements were mainly based; 2,627 county correspondents, with 7,881 aids, and 36,426 township correspondents, reporting each for his own immediate neighborhood. From this large body of persons, selected with great care not only as to their geographic distribution, but also as to their qualifications for the performance of the duties required of them, reports have been received monthly, and at the close of the calendar year a select body of farmers, numbering about 90,000, reported upon the crops of their own individual farms. The Department is indebted to numerous transportation companies for monthly returns of cotton carried over their respective lines, information which has been of the greatest value in the making up of its final returns on the production of cotton.

No important change in the crop-reporting system will be recommended until the approaching federal census shall have furnished the Department with a new and definite statistical basis as to the distribution of crop areas. The Department's system is based, in the main, upon a periodic comparison of the acreage devoted to particular crops with that so used in the preceding year, and it is consequently not only impossible to make any increase, during the closing years of an intercensal period, in the number of products reported upon, but it is difficult, even as regards those which are reported upon, to keep exact step with a fluctuating acreage and a constantly varying production when the cumulative effect of even a small annual error in a report based on percentages may reach large proportions. With a view to overcoming this difficulty as far as possible, it is respectfully recommended that two special agents be appointed for work in the field.

The important service that can be rendered to the Department by such officers was fully set forth in the Statistician's report for the fiscal year ending June 30, 1898, and it need only be added that the condition of the appropriation for the work of this Division will now admit of such appointments being made.

A PUBLICATION FOR CROP CORRESPONDENTS.

The improvement that is so gratifyingly in evidence in the reports of correspondents is largely attributable to the issue of a new monthly publication known as *The Crop Reporter*, designed for the exclusive use of the Department's crop correspondents. The necessity of compressing into very small space the instructions printed upon the monthly reports, the marked localization of the area of production in the case of not a few of the crops reported upon, and the general lack of uniformity in the agricultural methods and conditions obtaining in the different sections of the country have alike suggested the employment of some agency by which correspondents could be more fully instructed as to their duties and the instructions given them be better adapted to their various needs. Such an agency has been found in the new publication, which has been received with many expressions of satisfaction by correspondents in every part of the country. By anticipating their needs, interesting them in their work, making intelligible to them the relation which, as individual correspondents, they bear to one of the most important branches of the work of the Department, and putting in their possession, without trespassing upon the province of the agricultural journals, a great variety of information calculated to make them better judges of agricultural conditions and consequently more valuable correspondents to the Department, *The Crop Reporter* has been the means of greatly improving the crop-reporting service, while incidentally reducing the enormous correspondence of the Division by nearly one-half.

THE STATISTICAL LIBRARY.

The accessions to the statistical library, which, although an integral part of the general library, is segregated for the convenience of this Division, numbered during the year 2,100, increasing the total contents of the library to about 14,100 books and pamphlets. The necessity for the continued segregation of this library will be apparent when it is stated that during the fiscal year covered by this report about 10,000 letters were written in this Division in response to requests for statistical information that could not be furnished in printed form and much of which had to be obtained from sources other than the publications of the United States Government. These various demands involved the regular assignments of some of the most efficient clerks in the Division to the duty of compiling statistical information from the publications of State and foreign governments, agricultural and commercial organizations, and other bodies.

EXTENSION OF WORK TO NEW POSSESSIONS.

The approaching federal census will furnish the necessary basis for an extension of the crop-reporting system to the newly acquired possessions of the United States, and I respectfully recommend that

provision be made in the Congressional appropriation for the fiscal year 1900-1901 for the inauguration and maintenance of this work. I estimate the expense at a sum not exceeding \$8,000 per annum.

NEED OF A BUREAU ORGANIZATION.

I respectfully renew my recommendation that the necessary authority be obtained from Congress for the habilitation of this Division as a bureau. Not only, as set forth in the Statistician's report for 1897, does the work of the Division exceed in volume that of various offices in other Executive Departments which have the advantage of a bureau organization, but the varied character of that work and, still more, the extensive ramifications of the Division's crop-reporting system involve an infinitude of detail that makes constant demands upon the time and attention of the Statistician—demands, the number and imperative character of which are entirely out of proportion to the real importance of the matters to which they relate, that can not be otherwise dealt with under a divisional organization, and of which a more economical as well as more satisfactory disposition could be made under the organization of a bureau. No more fitting time could be chosen for the change of the Division into a bureau than the year in which the preliminary returns of the United States census will become available for the use of the Division and that expansion of its work be rendered practicable which is so necessary to the agricultural interests of the country.

THE PARIS EXPOSITION OF 1900.

During the latter part of the fiscal year the Statistician has assumed, under the Secretary's special order, the additional duty of preparing for the forthcoming Paris Exposition the United States Government cotton exhibit. While there has not been that generally hearty response to the invitations to furnish samples of cotton (not exceeding 25 cents each in value) addressed to cotton growers, of which self-interest, local pride, and national patriotism seemed alike to warrant the expectation, much valuable cooperation has been secured, and the exhibit promises to display, in all desirable completeness and attractiveness, the varied capabilities of the different sections of the cotton belt.

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